Motorship

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5 of the 11 Conversions

authorized in the 1927 Program
of the United States Shipping Board
will become

McINTOSH & SEYMOUR MOTOR SHIPS

The total horsepower allotted to
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by far the greatest given to any one
Diesel engine builder

McINTOSH & SEYMOUR
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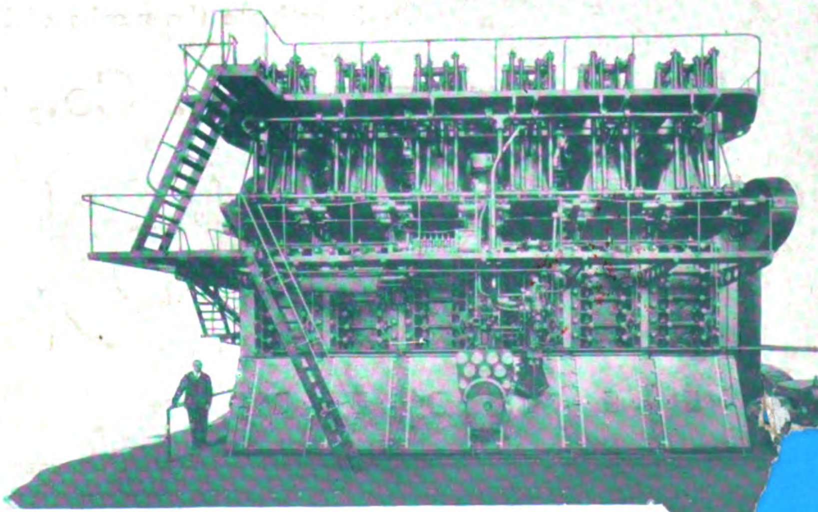
AUBURN, N. Y.



MAR., 1928

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Section O

Motorship

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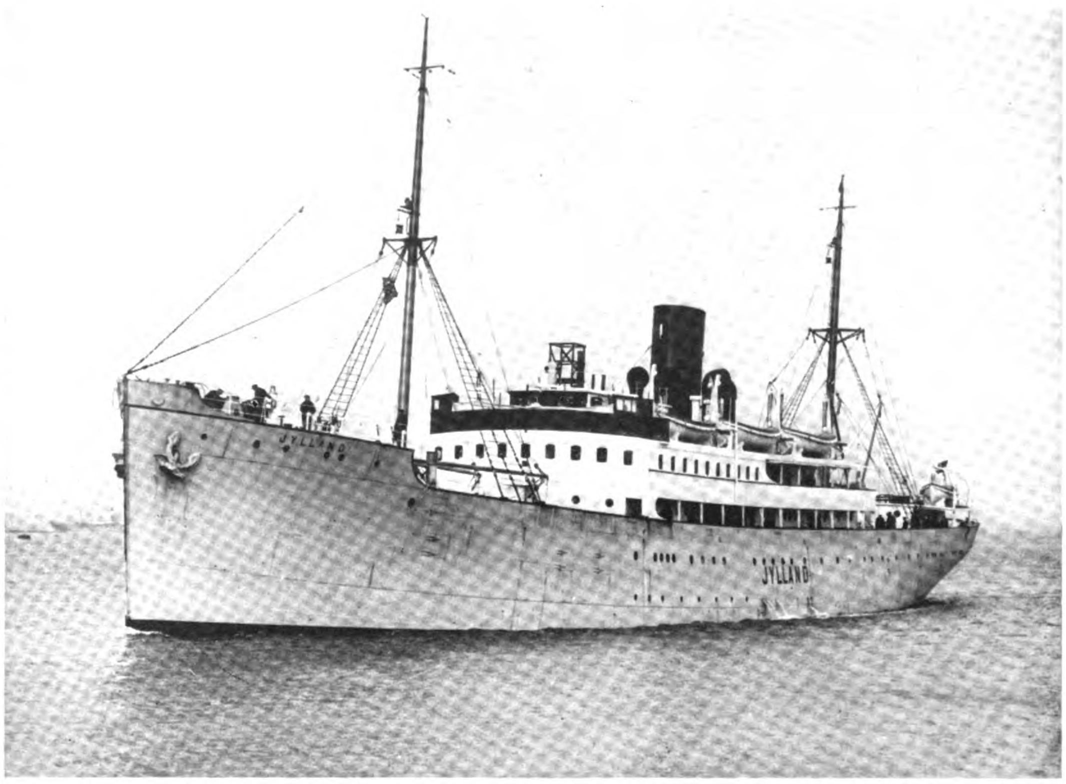
Volume XIII *March, 1928* *Number 3*

The Fast, Short Run Motorship Now An Established Fact

IT would seem that at last a very vital, if not a fatal, blow has been given to the old and stoutly maintained theory that the motorship is not applicable to short run services. One of the many companies controlled by Lord Kylsant has just placed an order with the Harland & Wolff Belfast yards for a fleet of three fast moderate sized passenger and mail packets to maintain a nightly service between Liverpool and Belfast. These ships when completed will replace an entire steamer fleet, which presumably will be transferred to less important service. Now these steamers which are to be replaced are not old ships; they are fast well-equipped oil burners, as popular as they are efficient. It would seem, therefore, that Lord Kylsant is very well assured that he will be placing in service ships which are vastly more efficient and economical with the advent of these new units. They are to be 19-knot ships, 345 ft. long by 46 ft. beam by 19 ft. deep and will be powered by two 10-cylinder 3000 hp. H. & W.-B. & W. Diesels—presumably of trunk piston type on twin screws. They will be the first Diesel propelled ships of so-called large cross-channel type to operate under the British Flag although two motorships of slightly smaller dimensions but of about 14-15 knots speed have been operating in the North Sea under Danish flag for some time. These are shortly to be augmented by further Diesel tonnage of the type shown.

Change of Address

On and after March 15, the offices of MOTORSHIP will be located at 101 West 31st Street, New York City.



This ship, which has a length of 304 ft., and 16 knots speed with 3100 hp., is a fast coastwise motorship operated successfully for two years by the United Ss. Co., Copenhagen

This whole matter of powering small fast ships was discussed very exhaustively in a special article which we published in the July 1927 issue of MOTORSHIP. In this we set forth the advantages to be obtained from Dieselizing such ships, the difficulties and limitations to be encountered. We gave dimensions and full particulars of 17 of such ships ranging all the way from the 428.8 ft., 4500 hp. THEOPHILE GAUTIER to the 235 ft. 1000 hp. URUGUAY. This list was a noteworthy one and there could now be added to it several ships in coastwise service in Brazil, a number of fast short run services for work in the Mediterranean and a 10,000 hp. 430 ft. ship recently ordered by the Adelaide Ss. Co. for service on the Australian coast. This ship will have a speed of about 16 knots with her 10,000 hp. These are just representative parts of the world where the coastwise motorship has broken in. Most of the runs in question are short overnight runs.

In America, which has 4,000,000 tons of coastwise shipping and the largest domestic mercantile marine in the world with some excellent coastwise ships, complete apathy to the potentialities of the Diesel seems to be the rule.

The coastwise motorship is no longer a problematic thing of the future—it is here now, and so far its powering has not been such a problem as many of us were inclined to think. Then, again, there have been many improvements in Diesel design during the last few months which all help to overcome some of the initial difficulties. Higher piston speeds in some engines are being accompanied by reductions in weight. The trunk piston engine has been developed considerably. Then, too, supercharging is just beginning to attract the attention it deserves. In particular it is worth noting that a small motorship recently made 21 knots with supercharged 4-cycle machinery.

The Small Diesel Engine—A New Field

NO one who visited the recent Motor Boat Show at New York could fail to be impressed with the attention given to, and the interest shown in, the small Diesel engine. The fact that we are describing no less than three new types of small high piston speed Diesels in this issue, all of which are now on the market, gives an indication of the importance which manufacturers are attaching to the type.

Actually such engines are produced in powers and sizes capable of doing much of the work hitherto considered as coming entirely within the field of the gasoline engine.

People are coming around to realize that Diesels of 50, 100, 200 hp. are cheaper to operate and possibly safer than corresponding gasoline engines. This applies to such craft as commuter type yachts, workboats, small cruising boats, and fishing boats. We have an example of this tendency in British Columbia waters today. Up to within the last four or five years, our correspondent in that district informs us, the fisherman seemed wedded to the 4-cycle gasoline engine and regarded any innovation with suspicion Among the halibut fleets especially, the very lives of the fishermen often depends on the perfect functioning of their engines.

The fishing banks in the open Pacific off the coasts of British Columbia and Alaska are subject to gales of great severity. Halibut fishing also requires an engine which can run at slow speed for long periods, while good power is required to get the catch to market as soon as possible as well as in good condition.

From fish carriers, the use of Diesel and surface ignition oil engines spread rapidly from actual fish carriers among the fishermen themselves, being installed both in cannery owned boats and in private craft.

The fishing population of this coast is drawn from almost every quarter of the globe except perhaps the sections occupied by the black races. The largest proportion are white, but the Indian tribes on the coast are born fishermen and there is also a large Japanese representation. Now, irrespective of race or color, they are becoming interested in oil engines of the small type.

What is true of the Pacific Coast fishermen is true also of fishermen in other parts of the country and of yachtsmen and owners of workboats and small craft.

The Diesel has lots of appeal to such people and for those who feel inclined to criticize its possible complication, designers, as our articles this month indicate, have built for strength and simplicity.

Report of the Federal Oil Conservation Board

THE second report of the Federal Oil Conservation Board says in effect that there is no danger of oil shortage as far as the United States is concerned. In the country's oil shale alone there are 92,000,000,000 barrels of recoverable oil.

The Board recommended that while there was no immediate need of developing oil from shale and coal, the study of the technical problems involved in the process should be carried on, as eventually the well oil in the country would be exhausted.

The substitution of alcohol for gasoline, the constant study of more efficient uses of all the products of petroleum, and the possible substitution of crude oil burning engines for the high compression motors now generally used are mentioned by the Board as means of conserving the supply of oil fuels.

In submitting the report, Secretary Work said that a third report presenting a worldwide survey of petroleum resources is in course of preparation.

Motorshipping and Motorliners in Italy

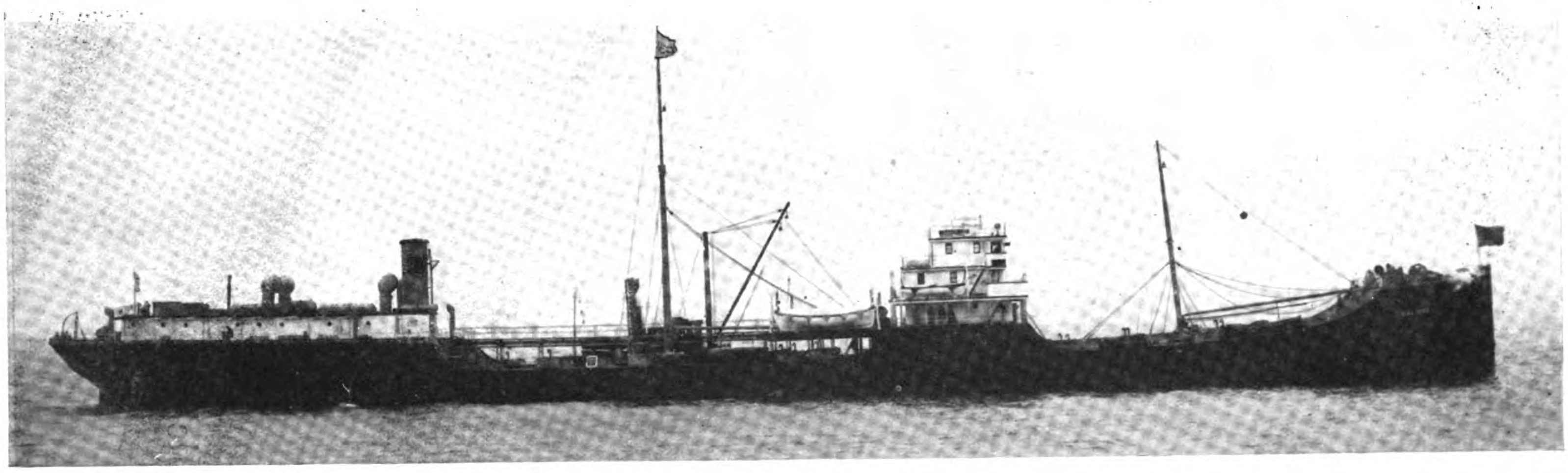
THE lively interest prevailing in Italian shipping and marine engineering circles regarding the performances of the newest passenger motorships AUGUSTUS and SATURNIA, suggests that the position of Italy as a first-class maritime power appeals with particular force to the people; while, to marine engineers, the advent of the motorship and its future rank among the most important subjects for discussion. It is currently believed that wonderful triumphs await the Italian motorship in actual practice. The Navigazione Generale Italiana, which has put the magnificent AUGUSTUS, of 33,000 tons gross, upon its South American service, is relying upon her achievements as proof of the superiority of Diesels over turbines (both of these are employed upon the vessels in the same company's service) and of motorships over steamships. Comparisons are being drawn and bets are even being made upon the performance of the AUGUSTUS and the ROMA, the latter being the newest turbine vessel, built twelve months before, with a tonnage of 32,500 and a slighly increased speed, namely 22 knots against the 20 knots of the AUGUSTUS. This motorship has the highest-powered marine Diesel installation at present in service, being fitted with four M.A.N. 2-cycle, double-acting Diesels, developing about 25,000 b.hp. at 120 r.p.m., but capable of augmenting to 28,000 b.hp. at maximum rating.

The shipyards of Ansaldo of Genoa, who built the engines of the AUGUSTUS, have under preparation plans for three other small fast motor vessels for the Civitavecchia-Sardinia subsidized line. The first of these vessels is to be fitted with two Tosi Diesel motors, while the others will have two M.A.N. motors.

The technical interest displayed here in the AUGUSTUS' achievements can be well understood, since upon these much of Italy's development in marine engineering depends. It is recognized, moreover, that all that happens today in this direction must be in keen competition with other countries, especially Great Britain, whose progress has been most striking since the launch of the AORANGI (17,500 tons), in 1925, to take her place in the transpacific service of the Union Steamship Company of New Zealand. Then followed the GRIPSHOLM, of 16,500 tons, completed in English yards to the order of the Swedish-American Line. This vessel is engaged in transatlantic service. The ASTURIAS and the ALCANTARA, of the Royal Mail Steam Packet Company, destined for the South American service, and the CARNARVON CASTLE, for the South African service, have proved thoroughly satisfactory. But whereas, until now, no great motorship has been constructed to do more than 20 knots, the fastest British steamship can exceed 22-23 knots sea speed. And, often it is the sea speed that counts in a great many trades.

It will be interesting to see whether motorships, besides developing trade through the Panama Canal, are likely to effect for the Mediterranean trade what steamships brought about, years ago, for Eastern trade passing through the Suez Canal. As was pointed out quite recently, although motorships were not thought of when the Panama Canal was built, the proximity of the Venezuelan and Mexican oilfields makes this type of vessel more and more suitable for trading with the Latin American countries. Italian shipowners are relying upon the performances of their ships to show the way in regard to South American routes.

With the AUGUSTUS, the SATURNIA shares the honor of being the largest Italian motorship afloat. This fine liner was turned out by the Cantiere Navale Triestino, of Monfalcone, for the Cosulich Line. On preliminary trials this vessel did 21 knots; but in proceeding to Naples and Marseilles no attempt was made to press her to do more than her service speed of 19 knots. The SATURNIA is driven by two double-acting 4-cycle motors of the B. & W. type. The Stabilimento Tecnico Triestino is responsible for the construction of the SATURNIA'S engines. Separate Diesel engines drive three large air injection compressors, two of which are for service and one for reserve. Three generators, two of which are of 900 kw. and one of 450 kw., and which are also driven by Diesel motors, provide the power for the electric lighting and the other purposes for which electricity is used on board this vessel, which contains, in all, about 400 electric motors. It may be taken for granted that, with splendid plants at their command, the Italians are making every effort to secure orders for Diesel engines from shipowners of all nationalities. These recent ships will prove an excellent advertisement for them.



Practical Conversion of Steam Tanker To Diesel Power

Sound Engineering Job Completed by Private Interests with Shipping Board Vessel at Cost of but $380,000— Only One More of Her Type Available

IN the spring of 1927, when the tanker charter market was at a high peak, the Anglo-Chilean Consolidated Nitrate Corporation purchased the 7,000 ton dw. steam tanker CHESTNUT-HILL from the U. S. Shipping Board for conversion to direct Diesel propulsion with the object of transporting fuel oil from California to its Chilean properties. It will be remembered that when notice of this project was first given in our May, 1927, issue we then informed our readers that Anglo-Chilean Nitrate Corp. had just completed a new Diesel plant at Coya Norte, Chile, to supply power for nitrate making purposes. The seaport for this plant is Tocopilla. Since conversion the CHESTNUT-HILL has been rechristened CALICHE, which is the Chilean name for nitrate ore.

In order to proceed quickly with this conversion, the owners, on their own initiative, purchased an 1,800 s.hp, 4-cycle, single acting marine engine which had already been completed by the McIntosh and Seymour Corporation in the Fall of 1922. They supplemented this contract with an order for two 100 kw. McIntosh & Seymour Diesels for driving Ridgway generators. The owners then secured the services of A. Conti, consulting engineer, New York, whose specialized knowledge in this field of work is well known to the marine world for, as Consultant to the Shipping Board, he effectively helped to translate Admiral Benson's conception of a Diesel conversion program into actual execution.

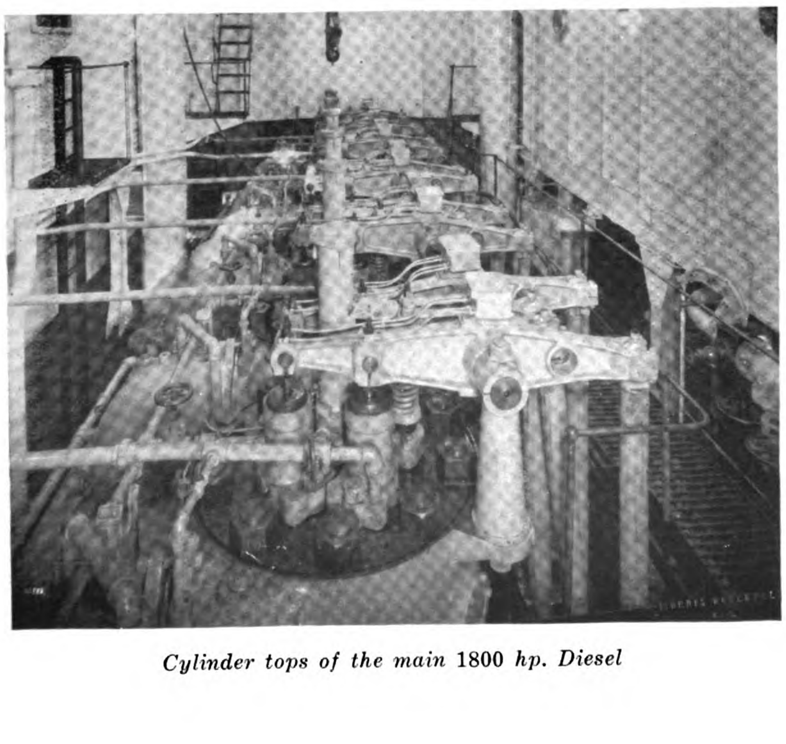
Characteristics of Caliche

Length b.p.	365 ft. 0 in.
Beam, molded	50 ft. 9 in.
Depth, molded	31 ft. 3 in.
Draft, load	24 ft. 5 in.
Displacement, at above	10,237 tons
Total capacity main tanks	51,500 bbl.
Total capacity summer tanks	5,900 bbl.
Dry cargo capacity	48,170 cu. ft.

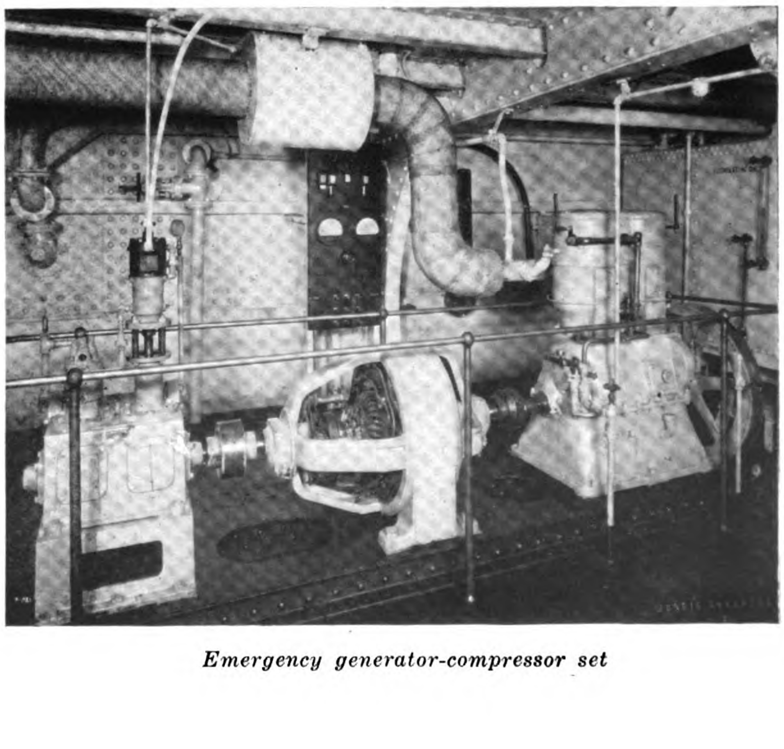
MS. CALICHE belongs to a group of six 7,000 dw. steam tankers, the construction of which was initiated for private accounts in the spring of 1916 by the Gloucester Plant of Pusey and Jones, but were commandeered, completed for U. S. Shipping Board, afterwards operated by the Naval Overseas Transportation Service for a period of about two years, and eventually laid up in 1921.

Of this group, four were purchased by the Atlantic Refining Company for conversion to Diesel-electric propulsion and the CHESTNUT-HILL, by the Anglo Chilean Consolidated Nitrate Corporation so that only one vessel, namely the BRANDYWINE, remains yet available for Diesel conversion at a nominal price.

On the morning of Saturday, January 28th, approximately 60 guests embarked at the Battery, New York to board the vessel waiting at anchor off Tompkinsville, S. I. As MS. CALICHE came to view through the snow storm, her trim silhouette conveyed the impression that one was no longer confronted with an obsolete steamer, rusty from seven years of lay-up, but with a thoroughly



Cylinder tops of the main 1800 *hp. Diesel*



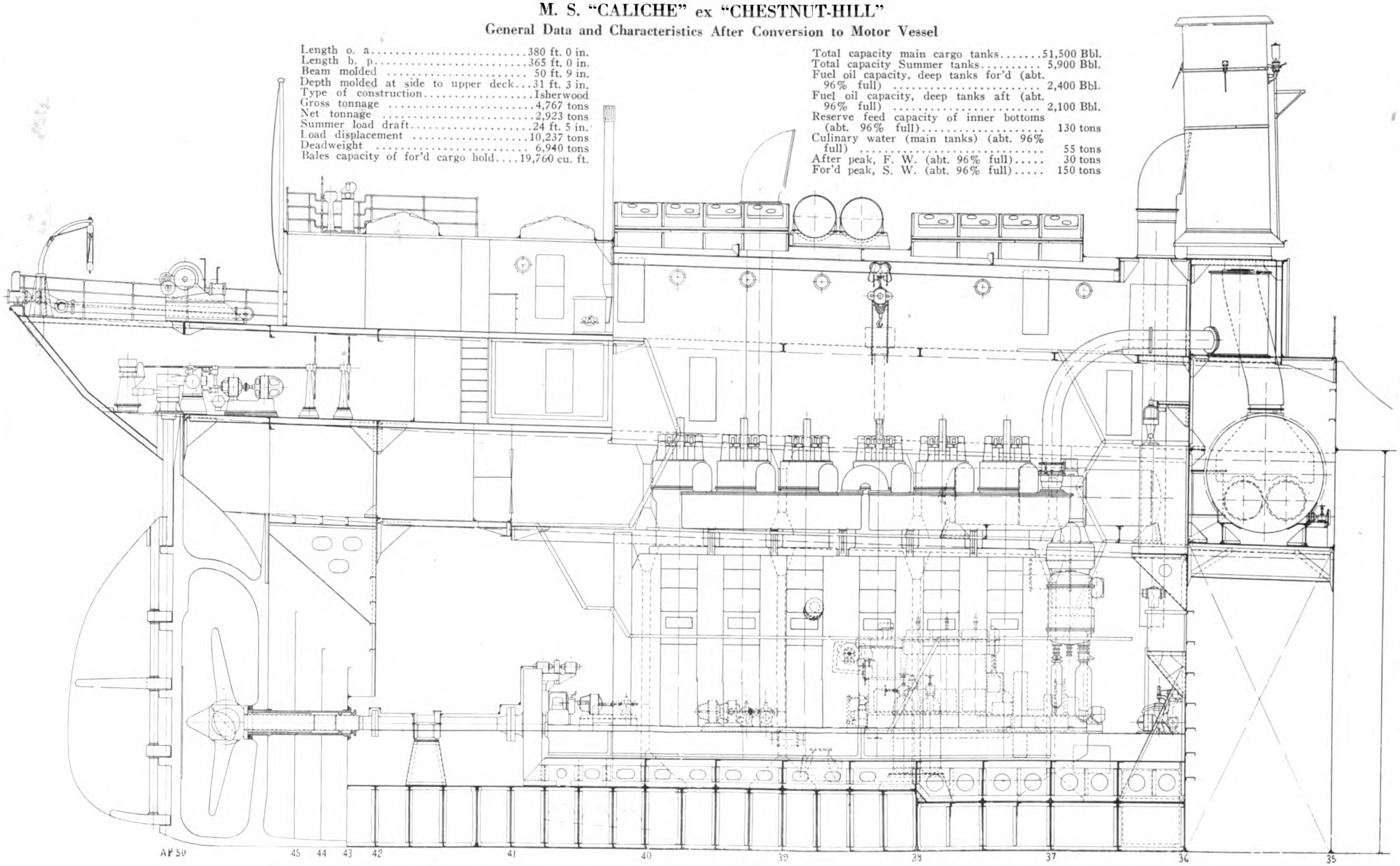
Emergency generator-compressor set

M. S. "CALICHE" ex "CHESTNUT-HILL"

General Data and Characteristics After Conversion to Motor Vessel

Length o. a.	380 ft. 0 in.
Length b. p.	365 ft. 0 in.
Beam molded	50 ft. 9 in.
Depth molded at side to upper deck	31 ft. 3 in.
Type of construction	Isherwood
Gross tonnage	4,767 tons
Net tonnage	2,923 tons
Summer load draft	24 ft. 5 in.
Load displacement	10,237 tons
Deadweight	6,940 tons
Bales capacity of for'd cargo hold	19,760 cu. ft.

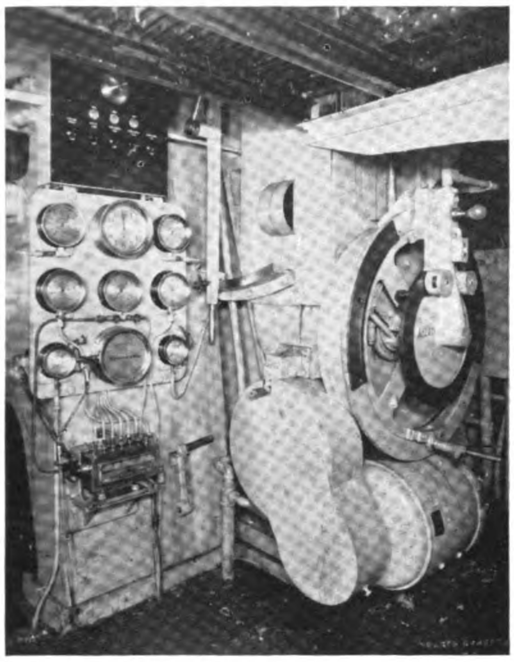
Total capacity main cargo tanks	51,500 Bbl.
Total capacity Summer tanks	5,900 Bbl.
Fuel oil capacity, deep tanks for'd (abt. 96% full)	2,400 Bbl.
Fuel oil capacity, deep tanks aft (abt. 96% full)	2,100 Bbl.
Reserve feed capacity of inner bottoms (abt. 96% full)	130 tons
Culinary water (main tanks) (abt. 96% full)	55 tons
After peak, F. W. (abt. 96% full)	30 tons
For'd peak, S. W. (abt. 96% full)	150 tons



Present Machinery Arrangement of the Converted Tanker Caliche

Careful examination of this elevation of the machinery space of Ms. Caliche shows the care which has been displayed in adapting the existing steamer hull to take the new machinery—a 6-cylinder 1800 hp. McIntosh & Seymour Diesel. Ms. Caliche is now carrying fuel oil from San Pedro to the Coya Norte (Chile) plant of the Anglo Chilean Nitrate Corp.

modernized vessel. Subsequent inspection, and the general behavior of the vessel and machinery in a heavy gale, completed the conviction that her transformation had been thorough and well done. From the variety of conversions which we have chronicled in the past, we have come to the conclusion that if Diesel power is to be adapted to existing conditions with a maximum of reliability and minimum cost, considerably more judgment must be exerted by the designer than in the case of new con-



Main engine control position

struction. In the case of Ms. CALICHE, a seemingly reliable and thorough transformation was obtained at reasonable cost.

In working out the new machinery arrangement, considerable structural alterations were necessary to provide for the main engine and attendant auxiliaries. Originally the CHESTNUT-HILL was propelled by a 2,400 s.h.p. General Electric double geared turbine with two, 3-furnace oil fired, cylindrical boilers of 5,200 sq. ft. heating surface and a small Scotch donkey boiler. The engine-room auxiliaries were largely steam driven while the forced draft blower, main cargo pumps and deck winches were operated by AC. motors, current being furnished by two 100 K. V.A. 3-phase, 60 cycle, 230 Volt General Electric turbo generators. For the ship's lighting system, a small transformer was used to convert current to 110 volts DC.

The vessel was also arranged as a combination coal and oil burner and had bunkers arranged alongside of the main boilers and on the 2nd deck, which deck also served as a flat for the donkey boiler, turbo generators and switchboard, machine shop and a number of other auxiliaries. It was, therefore, necessary to remove practically all the original steam plant, all transverse and longitudinal bulkheads and extend the engine room casing the full length of the engine room by cutting out the intervening 2nd deck plating. This was compensated by reinforcing the ship's structure in way of the main engine with a complete system of vertical pillars and strong beams, while reinforcing of the inner bottoms was largely accomplished by means of deep transverse brackets above the tank top plating, extending from the web frames to the longitudinal girders of the main engine foundation. A large number of intermediate brackets were also used to stiffen these girders and to distribute the main engine weight.

The arrangement drawings clearly show the construction adopted for the main and auxiliary engine foundations as well as the structural arrangement of pillars and strong beams. Its effectiveness may be gauged by the fact that during the torsiograph tests, when the engine was operated over a wide range of revolutions, no vibrations were felt anywhere in the engine room or over the stern. We also noticed that the main engine was particularly free from "swaying" and that the vertical motion of the cylinder tops was almost imperceptible and certainly less than that observed in some conversions, which may be accounted for by a combination of such factors as good balance, and heavy construction of engine framing and foundations. Naturally, this being a 6-cylinder, 4-cycle engine with the cranks set at 120 deg., all the primary and secondary free forces and couples are balanced except for the compressor. But as the weight of the compressor's revolving and reciprocating parts is small, the resulting unbalanced forces are of little consequence.

The main engine was the first large marine unit built by McIntoch and Seymour Corporation and embodies a number of important features some of which were followed in the later and larger engines built for the Shipping Board. The engine is cooled by salt water throughout; the returns from the guides and pistons are arranged as an open system and collect into a common pipe leading to the forward bilge well, while the discharge pipes from cylinder jackets and heads are led to a collector box, thence overboard. There are six cylinders of 29 in. bore and 48 in. stroke, developing collectively 1800 s.hp. at the moderate speed of 105 r.p.m. with a corresponding m.i.p. of 95 lb. per sq. in. and a piston speed of only 840 ft. per min. The crossheads are fitted with a single slipper with backing guides; a division plate is arranged under the cylinders and the piston rods project through stuffing boxes fitted with metallic packing.

The main moving parts are forced lubricated by two independent motor driven pumps, the cylinders are lubricated by Richardson-Phoenix mechanical lubricators, while the operating gear is hand oiled. The main frames are of "A" type of rigid cast iron construction whereas on later engines they were made of cast steel, thereby effecting a material saving in weight. Double twin exhaust and inlet valves are fitted to each cylinder head, each pair being operated by a common rocker arm and the typical arrangement of long push rods.

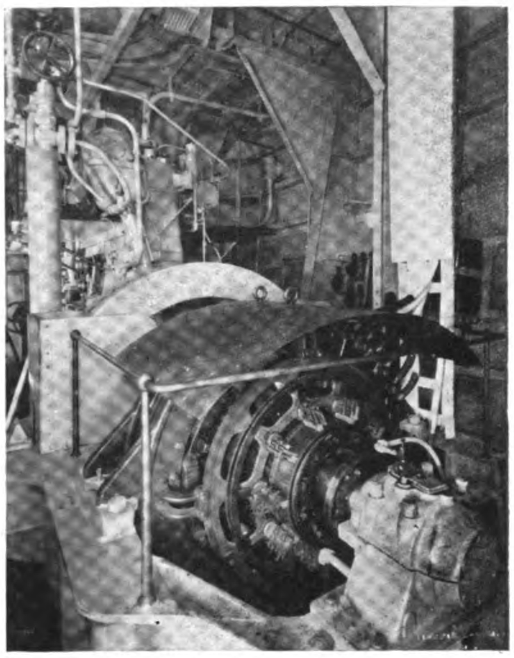
Starting, stopping and reversing is performed by swinging the rollers clear of the cams and by shifting the cam shaft in the desired position, which operations are all automatically performed by an electrically operated gear fitted with a 15 hp. slow speed General Electric motor. A hand gear is also fitted for varying the lift of the fuel valve needles, thus resulting in economy of compressed air at reduced speed. We were particularly impressed with the strong housing construction of the thrust bearing bolted directly to the after end of the bed plate, which undoubtedly simplifies and reduces the cost of engine foundations and appears particularly desirable for tankers with machinery located well aft.

The two auxiliary Diesel generators are similar in design to the units furnished by McIntosh and Seymour to the Shipping Board with the same design of oversize compressors furnishing air to the maneuvering tanks or to the main engine in the event of breakdown to the main compressor. The units of Ms. CALICHE, however, have three cylinders and are, therefore, better balanced; the smooth running of the port auxiliary generator, which was operated throughout the trials, being particularly noticeable.

The general data and characteristics after conversion can be noted from the attached table; the type, size and make of main and auxiliary equipment being summarized therein.

The arrangement of machinery is illustrated by drawings and photographs reproduced herewith, from which it will be noted that the principal auxiliaries needed for the operation of the main engine are all electrically driven and well located near the operating stand.

In order to reduce first cost, with no serious impairment of economy, the auxiliaries intermittently operated are steam driven, thus utilizing part of the original equipment;



One of two auxiliary generator sets

whereas, as previously remarked, all the auxiliaries in continuous operation are electrically driven.

For this reason the steam windlass was retained and the alternating current winches, which had badly deteriorated during the long lay-up, were substituted with Lidgerwood steam winches while the original Brown steam tiller, controlled by shafting from the bridge, was replaced by an electro-hydraulic steering gear fitted with telemotor control.

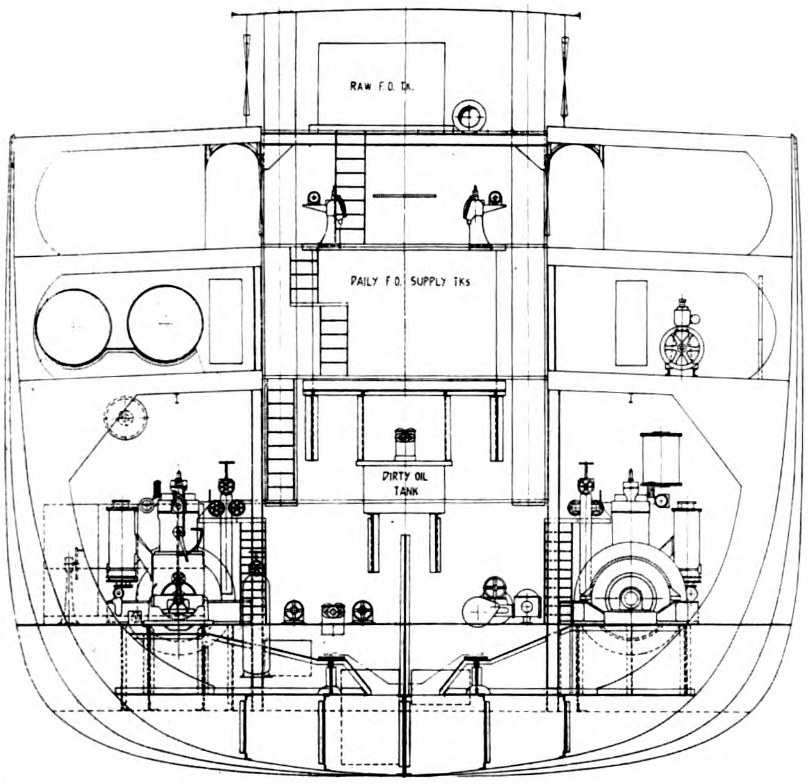
In order to avoid operating the steam plant at sea and to permit starting the donkey boiler, the fire and ballast, fresh water and feed pumps, can be also operated with compressed air, through flexible hose connections, from a reduced pressure line taken from the main starting tanks. Likewise, to avoid using the large Diesel generators in port, the donkey boiler blower and fuel oil units are driven by 115-volt motors connected to the lighting, so as to operate from the emergency generator.

As previously remarked, the original ship's lighting system was arranged for 110 volts and in order to utilize the old wiring and distribution panels, and also to dispense with a motor generator, the two 110 kw. Diesel generators were arranged for parallel operation on the three wire system, and their main circuit breakers so interlocked with the emergency generator as to prevent its potential being impressed on the busses when one or both of the main generators are operating, and vice versa.

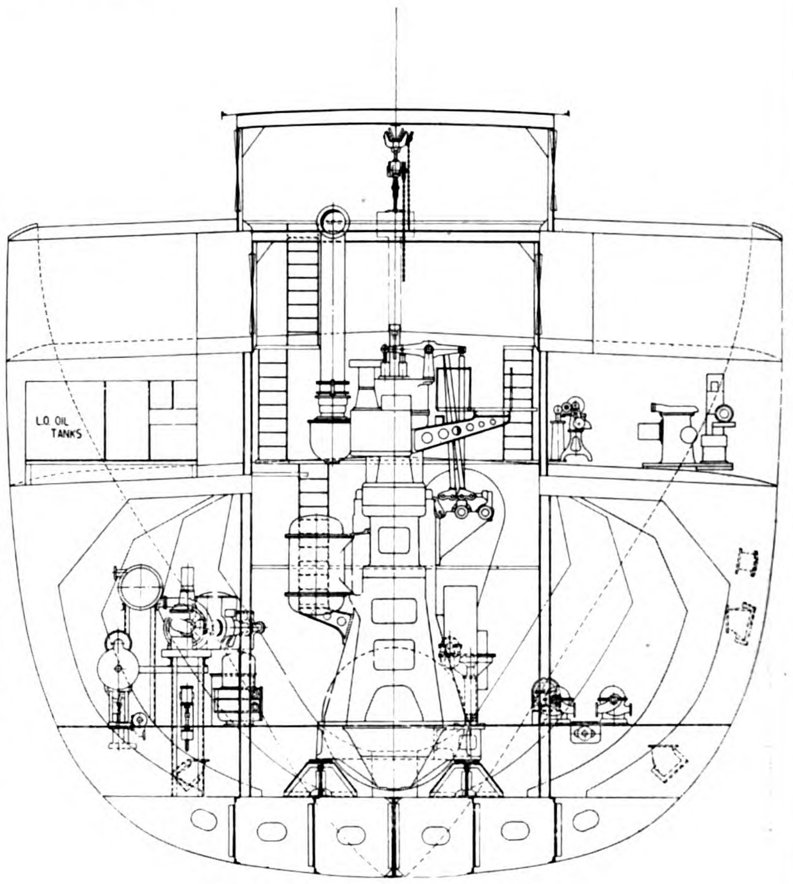
The switchboard, with motors, and controlling equipment was furnished by the Westinghouse Electric and Manufacturing Company. The controls for the motors located near the operating stand are mounted on the main switchboard, so as to be readily accessible to the engineer on watch, while the more remote motors have manual control enclosed in drip proof cabinets, located near the motors. In all cases, the controlling equipment consists of accelerating contactors, overload relays with automatic resetting and low voltage releases.

Machinery Arrangement of the Motor Tanker Caliche

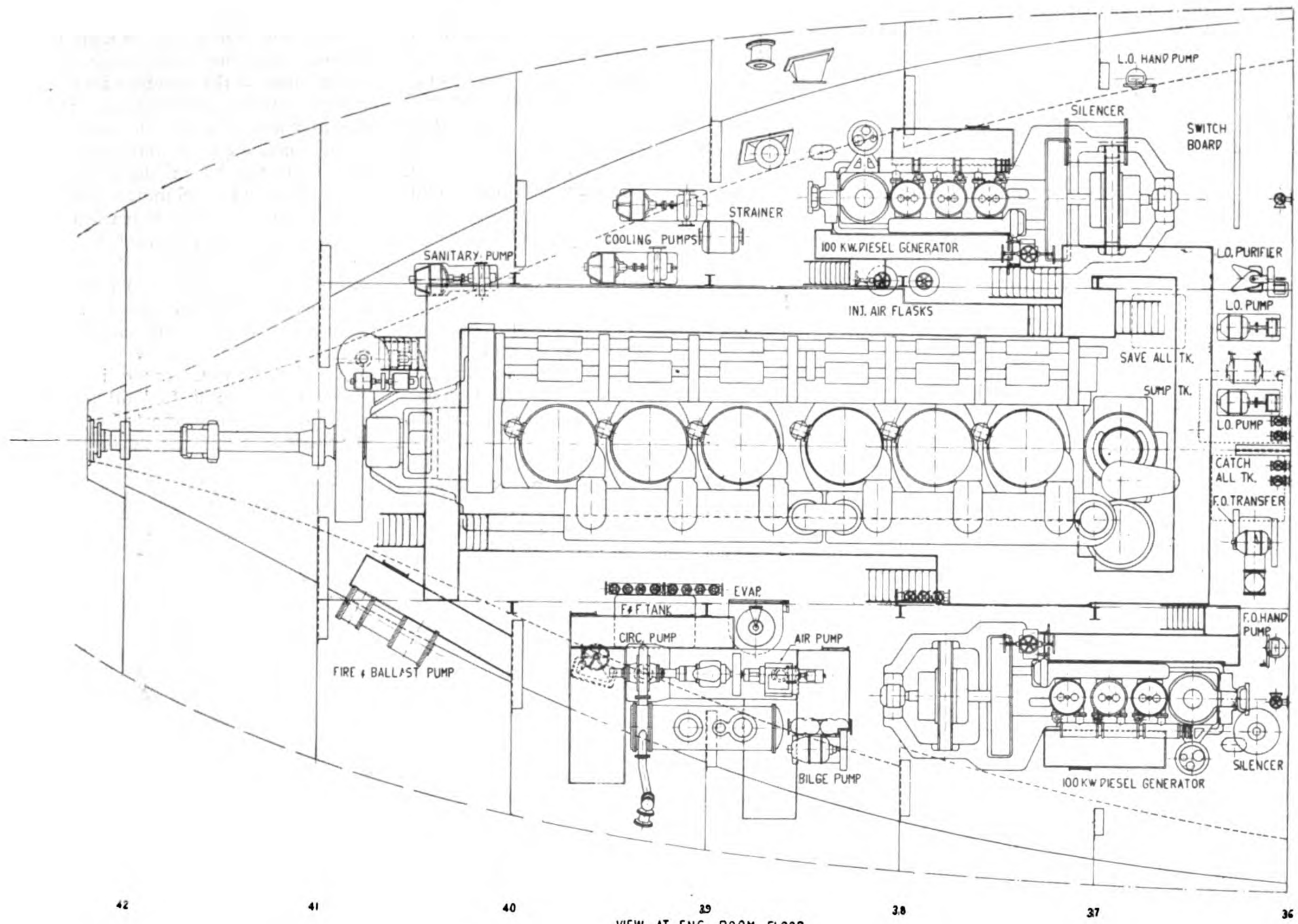
(Converted by Staten Id. Sb. Co.)



Section showing engine seatings and auxiliary generators



Section in way of main machinery



VIEW AT ENG. ROOM FLOOR

The control for the cargo pump motors is also mounted on the switchboard, with a relay cabinet for the blower motor located in a separate control room amidships, and so arranged that the pump motors cannot be started until the ventilating fan first operates for a period of two minutes, this arrangement being similar to the control of the motor tanker GULFPRIDE, also furnished by Westinghouse.

In addition to all work incidental to the Diesel conversion, the vessel was thoroughly overhauled and certain hull improvements were made to fit her particular trade, such as a slight re-arrangement of quarters to provide accommodations for four passengers, a new walkway between the poop and the bridge and a new 10 in. oil stern discharge.

Coming now to the question of cost, we are indebted to the owners for permitting us to state that all the work properly chargeable to conversion amounted, in round figures, to $380,000. This figure includes shipyard installation, main engine and spare parts, new shafting and propeller, engine room auxiliaries, steering gear and such miscellaneous expenses as freight, traveling, inspection and superintendence. It also includes the cost of cargo pump motors, control equipment and cables as these items could not be readily segregated from the rest of the electrical plant. This is equivalent to about $55.00 per D. W. T. which is indeed quite low for a small tanker. Had the vessel been, say a 10,000 ton tanker, the same high grade installation could have been obtained at a much lower cost per deadweight ton, owing to the fact that the increased size would have had little or no effect on quite a number of items. Assuming that for the larger tanker a 2200/2300 s.hp. engine had been used, its cost would have been only about $40,000 greater, while the shipyard installation might have increased about $30,000, thus bringing the total figure to approximately $450,000 or only $45.00 per D. W. T.

If from the cost figures for the Shipping Board Diesel conversion program, published in our last month's issue, we omit such items as special alterations, repairs to hull, equipment and outfit, we obtain a total of $623,000 for the CROWN CITY and $636,000 for the SAWOKLA corresponding to $74.00 and $69.000 per dw.t., respectively. We feel, therefore, that Mr. Conti deserves credit for producing such a conversion at so reasonable a cost. This is, no doubt, due to the fact that all the working drawings, both engineering and structural, were developed by Mr. Conti's office concurrently with the specifications so that quite a number of the most important plans were thus made available to the bidders.

Ms. "Caliche"—Description of Main and Auxiliary Equipment

MAIN ENGINE:

1—McIntosh and Seymour Corporation 4-cycle, single-acting, 6-cylinder, 29 in. bore, 48 in. stroke, rated 2400 i.hp. or 1800 s.hp. at 105 r.p.m., corresponding PS 840 ft. per minute, m.i.p. 95 lb. per sq. inch, MEP 71 lb. per sq. in.

SHAFTING:

1—Propeller shaft (old) 13¾ in. Mean diam., 14 ft. 2¾ in. long.
1—Section of Line shaft (new) 13¾ in. diam., 11 ft. 0 in. long.
1—Thrust shaft and thrust bearing furnished with engine.

PROPELLER:

Designed for 1850 r.hp. at 105 r.p.m. and 10.5 knots. Built up type C.I. hub and four Manganese bronze blades. Diam. 15 ft. 3 in. Pitch 10 ft. 9 in. Protected area 57 sq. ft. Developed area 63.4 sq. ft.

STARTING AIR TANKS:

2—350 cu. ft. capacity each—400 lb. pressure.

INJECTION FLASKS:

2—17 cu. ft. capacity each.

AUXILIARY DIESELS:

2—McIntosh and Seymour Corporation 4-cycle, single-acting, 3-cylinder, 13 inch bore 18 in. stroke, rated 150 b.hp. at 265 r.p.m., corresponding PS 795 ft. per minute, m.i.p. 62.5 lb. per sq. inch. Each unit drives a three-stage oversize compressor having an excess capacity of 165 cu. ft. of free air per minute to refill the starting air tanks and to supply injection air to main engine in case of mishap to the main compressor.

MAIN GENERATORS:

2—Ridgeway 100 k.s. 3 wire 230/115 volt DC.

EMERGENCY GENERATOR and COMPRESSOR SET:

1—Self-starting 13 b hp., 550 r.p.m., 2-cylinder Hill Diesel engine driving an 8 k.w. 115 Volt DC, 2 wire Marine type, General Electric Company generator, and a Rix 3 stage emergency compressor having a capacity of 12 cu. ft. of free air per minute and suitable for 1000 lb. per sq. in. pressure.

SALT WATER COOLING PUMPS:

2—Worthington Standard Horizontal Splitcase Centrifugal Pumps rated 700 g.p.m. against 35 lb. pressure, guaranteed efficiency 74%. Driven by a 20 hp., 230 Volts constant speed, 1750 r.p.m. Westinghouse SK, Marine type, motor. Pumps and motors are fitted with ball bearings.

SANITARY PUMP:

1—Worthington Standard Horizontal Splitcase centrifugal pump rated 200 g.p.m. against a pressure of 45 lb. guaranteed efficiency 67%. Driven by a 10 hp., 230 Volt DC, 1750 r.p.m. constant speed Westinghouse SK, Marine type, motor. Pump and motor fitted with ball bearings.

LUBRICATING OIL PUMPS:

2—Herringbone type lubricating oil pumps. Size S 6-A 5 each rated 100 g.p.m. 35 lb. pressure at 1750 r.p.m. driven by a 5 hp., 230 Volt DC variable speed 1750/1150 r p.m. Westinghouse SK Marine type motor. Pumps and motors are fitted with ball bearings.

FUEL OIL TRANSFER PUMP:

1—National Transit Pump Company horizontal duplex 5¾ in. x 6 in., capacity 90 g.p.m. against 30 lb. pressure at 35 r.p.m. This pump is driven through double reduction geers with a reduction ratio of 38 to 1 by a 5 hp., 230 Volt DC 1330/800 r.p.m. variable speed Westinghous SK Marine type motor, fitted with ball bearings.

ENGINE ROOM BILGE PUMP:

1—Vertical duplex double acting 2 throw Bethlehem Weir 8 in. x 7½ in. Capacity 250 g.p.m. against 20 lb. discharge pressure at 45 r.p.m. Driven through double reduction spur gears, reduction ratio 20 to 1, by a 10 hp., 230 Volts, DC variable speed 900/600 r.p.m. Westinghouse SK Marine type motor, fitted with ball bearings.

FIRE and BALLAST PUMP (Old):

1—Horizontal Duplex 10 in. x 8½ in. x 10 in. National Transit Pump Company. Draws from sea and bilge system and discharges to firemain and overboard.

FUEL OIL SEPARATORS:

2—No. 5 A-200 gal. per hour, Sharpless super-centrifuges. Pressuretite type driven by 1½ hp., 230 Volts DC, 3450 r.p.m., Westinghouse SK Marine type motor.

LUBRICATING OIL SEPARATOR:

1—No. 3A 200 gal. per hour Sharpless centrifuge, open type, driven by 1½ hp., 230 Volt DC, 3450 r.p.m., Westinghouse SK Marine type motor.

FUEL OIL HAND PUMP:

1—Rumsey Rotary Pump No. 5. 2½ in. suction, 2 in. discharge.

LUBRICATING OIL HAND PUMP:

1—Rumsey Rotary Pump No. 5. 2½ in. suction, 2 in. discharge.

DONKEY BOILER (Old):

Built by N. Y. Shipbuilding Company 9 ft. 6 in. inside diameter, 9 ft. 0 in. long between heads, 2-33 in. I. D. corrugated furnaces 108-3 in. O. D. tubes. Total heating surface 658 sq. feet. 125 lb. working pressure.

OIL BURNING EQUIPMENT FOR DONKEY BOILER:

Manufactured by the Frank A. Holby Corporation. Consists of a combination forced draft blower and fuel oil pump driven by a 1½ hp., 115 Volt DC 3450 r.p.m., constant speed Westinghouse type SK Marine motor. The blower has straight radial vane impeller enclosed in a cast-iron casing and has a capacity of 250 cu. ft. of free air per minute against a discharge head of about 5 ounces. A spur gear type fuel oil pump is driven through a worm gear, and is fitted with a spring leaded relief valve by-passing to the suction which regulates the capacity and pressure. The oil flows through the spindle and is atomized by centrifugal force. The air turbine is actuated by the forced draft blower and supplies air for primary combustion, which induces a flow of secondary air through the adjustable registers. Both pumps are in duplicate.

FEED PUMP:

1—Bethlehem-Weir vertical simplex 6 in. x 4 in. x 7 in. With 125 lb. steam pump has a normal capacity of 5000 lb. of water per hour against 150 lb. discharge pressure at 16 d.c.p.m.

STEAM INJECTOR:

1—No. 11½ Model "O" Metropolitan, double tube, 1½ in. injector by Consolidated Ashcroft Hancock Co.

VACUUM PUMP: (Old)

1—6 in. x 6 in. x 6in. Horizontal duplex National Transit Pump Company. Draws from the cargo oil heating coils and discharges through an inspection tank.

FRESH WATER PUMP: (Old)

1—Horizontal duplex 5¾ in. x 4¾ in. x 5 in. National Transit Pump Company. Draws from the fresh water tanks and discharges to the gravity tanks.

AUXILIARY CONDENSER EQUIPMENT: (Old)

Consists of 1—785 sq. ft. 2 pass cylindrical cast-iron condenser capable of condensing 6000 lb. water per hour with water a 70° F.
1—6½ in. x 6 in. vertical steam cylinder which drives a 5 in. centrifugal single suction circulating pump at one end a Rotex air pump at the other end. The complete equpment was built by the C. H. Wheeler Company.

EVAPORATOR: (Old)

1—20 ton vertical Navy type Evaporator.

WORKSHOP MACHINERY:

The following equipment is driven through belting and counter-shafts by a 5 hp., 230 Volt DC 1750/1150 r.p.m. variable speed Westinghouse type SK Marine motor.
1—Engine lathe 14 in. x 10 ft. Davis National Tool Company.
1—Radial Drill 30 in. swing, capable of drilling up to 2½in. by Dreses National Tool Company.
1—Shaper 16 in. stroke, Cincinnati National Tool Co.
1—Grinding Machine by Manning, Maxwell and Moore.

DECK MACHINERY:

Windlass (old) one—9 in. x 9 in. Steam driven spur gear-American Engineering Co.
Two—⅛ in. chain Mooring Winch (new) one—8¼ in. x 8 in. double geared, Lidgerwood Mfg. Co.
Cargo Winches (new) Two—8¼ in. x 8 in. single gear, Lidgerwood Mfg. Co.

STEERING GEAR: (New)

1—No. 5 American Engineering Company Electro-hydraulic steering gear with opposed 9 in. rams. Designed for 30 in. hard over to hard over and a guaranteed torque of 1,650,000 in lbs. The Hele-Shaw Pump is mounted on a common bed plate with the driving motor which is a 12 hp., 800 r.p.m., compound wound Westinghouse type SK Marine Motor. This gear is fitted with telemotor control from the Bridge and an emergency steering station aft acting directly on the Hele-Shaw Pump in case of mishap to the telemotor.
The old hand steering gear operating a separate quadrant through a worm and worm wheel has been retained.

MAIN GARGO PUMPS:

The original two 10 in. x 12 in. horizontal duplex National Transit Pumps were driven by a 60 cycle AC, 230 Volt, 1800/900 r.p.m. variable speed synchronous type motor mounted on top of the pump housing, driving the crank shaft through a set of double reduction gears having a combined reduction ratio of 29 6 to 1. These motors were replaced with 70 hp., 230 Volt DC, 1500/900 r.p.m. variable speed Westinghouse SK, water-tight motors, fitted with bearings of the sealed sleeve type, and the pumps were correspondingly slowed down from 60 to a maximum of 50 r.p.m. These motors are completely enclosed and externally ventilated by a Sturtevant blower of 2500 CFM against 2 ounce pressure, driven by 1½ hp. constant speed 1180 r.p.m., shunt wound Westinghouse SK Marine type motor.
The blower unit together with control panel, starting switches and gauge board are located in a separate control room on the main deck under the bridge.
The bilges of the main cargo pump room are protected by a battery of five CO_2 Lux extinguishers.

REFRIGERATING PLANT (Old):

Consists of a 2 ton ammonia motor driven compressor built by the Brunswick Refrigerating Company. The motor is 5 hp., 230 Volt DC, 1750/1150 r.p.m. variable speed Westinghouse SK Marine type. The ice making tank has a capacity of 240 lb. of ice per day. The cold storage space has 1300 cu. ft. divided into 3 compartments.

GALLEY RANGE:

Supplied by the New York French Range Company and is a heavy duty range similar to those installed on the Shipping Board converted motorships. The oil burning equipment was furnished by the Frank A. Holby Corporation and consists of a small oil burner operated by gravity from an overhead oil storage tank and by compressed air at about 2 lb. pressure taken through two reducing valves from the main engine starting air tanks.

The Editorial Viewpoint

Survival of the Fittest

"......A CAREFUL PERUSAL of the engineer's log disclosed conditions in sea service that strengthens the conviction that marine history is being written by the advent of the Diesel engine." Thus in the N. Y. *Times* of Sept. 26, 1912, John J. Bogert, consulting engineer of New York, predicted the present day supremacy of the motorship after inspecting the first Diesel propelled vessel to call at the port of New York—the CHRISTIAN X.

At that time there were hardly more than 50 motorships in the entire world's shipping fleet. But in the 15 years which have succeeded the maiden voyage of the CHRISTIAN X, shipping men have witnessed a revolution in marine transportation methods. Dieselized vessels are now counted by the thousands; they have been tried, tested and proven; they are obsoleting the steamship.

It is relatively easy to determine the underlying reason for this tremendous development and change. Progress has always demanded that method which produces the desired results in the most satisfactory, economical and efficient manner. The motorship—extremely economical to operate, free from soot and the usual steamship dirt, capable of making long voyages without refuelling, efficiently applying the power of the fuel direct to the propeller shaft, dependable—embodies those simple essentials of progress, and its adoption was natural.

While it is true, there still are ship operators who do not favor the motorship, will they not be obliged to "carry on" in face of the severe competition offered by the Diesel powered vessel operating at one-quarter the expense? To us that doesn't appear to be profitable.

The A.E.G.-Hesselman Engine

MERELY AS A VEHICLE of Dr. Sass's much-published article on the Hesselman-A.E.G. double-acting two-cycle engine the Transactions of the Institute of Marine Engineers (London) for the December, 1927 Session, would call for no particular comment. Dr. Sass's paper has been virtually syndicated, so much so that a review of its proper text would be superfluous.

The Transactions, however, go a great deal further than merely to provide another printing. They furnish a critical discussion by members of the Institute, whose reproduction of the paper is thereby placed in a class sharply distinguished from the necessarily passive handling of many periodicals. Members of the Institute have shown a notable aptitude for more than keeping pace with the rapid Diesel engine developments that have taken place within the last decade and their keen comment on Dr. Sass' paper clearly shows it.

Mr. Chaloner, for instance, wants to know what peculiarities of the Sass engine required subjecting it to a special research on scavenging, in view of the fact that it does not appear to go beyond the mark already set in published researches. Forged manganese steel for the cylinder liner excites the curiosity of Mr. Hutchinson, Mr. Calderwood is skeptical about the maintenance of 60 fuel sprays in a single engine, while Mr. Stead thinks that "A sea-going engineer has enough to do without being asked to become a watchmaker too."

It is not for us to say to what extent any implied defects are founded on fact, nor how adequately Dr. Sass disposes of them in his reply. But in providing light, shadow, and perspective, the discussion in question easily outshines other comments that have been made of the report on the Hesselman-A.E.G. engine.

The Motorliner Saturnia

THE BIG MOTORLINER SATURNIA—the pride of a virile and growing Italian merchant marine—docked in New York on February 16.

Italy has today risen to a position of prime importance as a shipbuilding and shipping nation. A thorough realization of the present day needs of passengers in sea transportation, fostered by government aid, has made this possible.

Italy's shipyards are busy building ships not only for the Italian merchant marine, but for foreign nations, too. Her shipbuilders consider themselves well equipped to cater for the American shipowner who cannot afford to build at home. Italy has embraced the motorship as the cheapest instrument of ocean transportation.

The 23,900 ton motorliner SATURNIA is an example of the highest expression of motorshipping.

(Owing to extreme pressure on our space, a number of editorial notes have been held until the April issue.)

Nordberg and Fulton Get Shipping Board Diesels

IN the February issue of MOTORSHIP, we mentioned that bids for the auxiliary Diesels, generators and compressors for the recently converted Shipping Board motorships, were opened as we went to press.

We have just received official figures from the Shipping Board, and we present to our readers a complete summary of the results. Contracts have been let for the purchase from the Nordberg Manufacturing Company of Milwaukee, Wisconsin, of twelve, 3-cylinder, 500 b.hp., Nordberg-Fiat Diesels, at a cost not greater than $426,840.00; and also four 3-cylinder, 280 b.hp., Diesels from the Fulton Iron Works Company, of St. Louis, Missouri, at a cost not greater than $107,232.

While there are but 6 items in the original bid as arranged by the Shipping Board, it will be noted that several bidders have evidently modified their bids offering details differing slightly from the contract in order to conform with the particular type of machinery they manufacture. A full description of the machinery referred to by the various items may be found in the complete specifications.

Summary of Bids for Shipping Board's Diesel Auxiliaries

Bidder and Make of Engine	Make of Generators	4 Small 3-Cyl. Engines with Compressors Item No.	Bid	12 Large Engines with Compressors Item No.	Bid
Bethlehem	General Electric	2 and 3	$126,159.00	5 and 6	$568,052.00
Busch-Sulzer	Westinghouse	No bid		4	$590,184.00
Busch-Sulzer	Westinghouse			4a	$533,484.00
Busch-Sulzer	Westinghouse			5 and 6	$573,600.00
De La Vergne	Westinghouse	2 and 3	$178,920.00	5 and 6	$760,160.00
C. & G. Cooper	Westinghouse	2 and 3	$112,332.70	No bid	
Fulton Iron Works	Westinghouse	1	$109,589.87	4	$443,763.95
Fulton Iron Works	Westinghouse	2 and 3	$126,822.35	5 and 6	$493,463.05
Fulton Iron Works	Westinghouse			7 and 8	$495,163.95
McIntosh & Seymour	Westinghouse	1	$156,639.80	4	$650,942.40
McIntosh & Seymour	Westinghouse	2 and 3	$172,618.70	5 and 6	$719,114.10
New London	Westinghouse	No bid		5 and 6	$458,656.00
New London	Westinghouse			5b and 6b	$488,656.00
New London	Westinghouse			5a and 6a	$423,546.00
Nordberg	Westinghouse	No bid		5 and 6	$437,580.00
Worthington	Westinghouse	2 and 3	$185,982.90	4	$585,708.00
Worthington	Westinghouse	3a	$223,790.74	5 and 6	$589,862.70

Note: Ingersoll-Rand Co. only bid $740,822.00 for entire order of 16 engines.
Note: Fairbanks-Morse Co. bid incomplete—no compressors included.

Explanation of Item Numbers

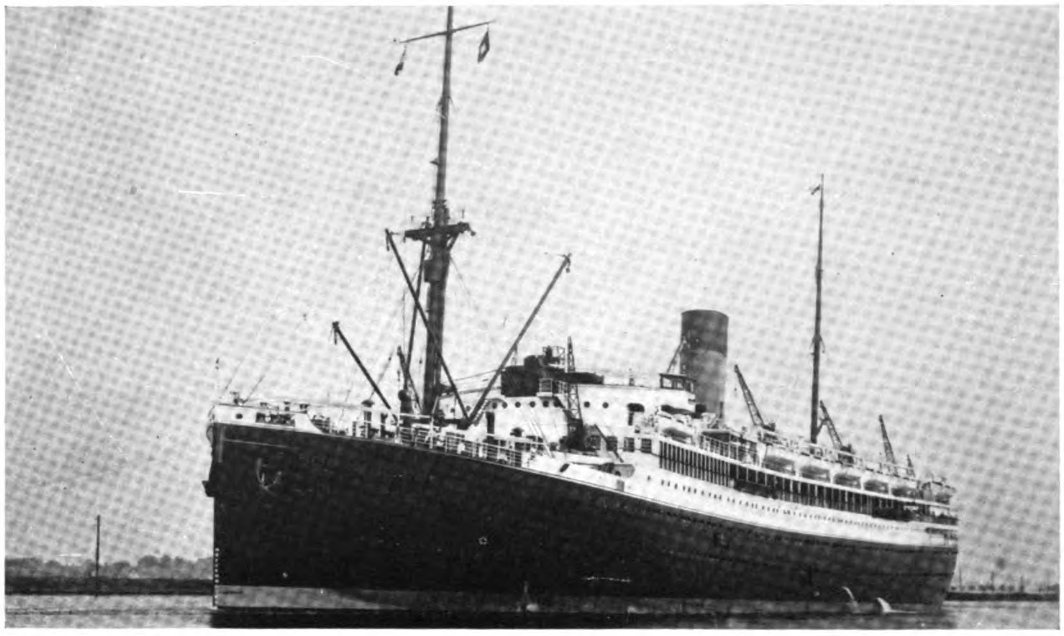
Item No. 1 Small 3-cylinder engines with oversize compressor.
Item No. 2 Small 3-cylinder engines with normal injection air compressor.
Item No. 3 Engines and compressors of Item No. 2, with generator shaft extended to drive 550 cu. ft. emergency compressor.
Item No. 4 Large engines with oversize compressor.
Item No. 5 Large engines with normal air injection compressor.
Item No. 6 Large engines and compressors of Item No. 5, with generator shaft extended to drive 550 cu. ft. emergency compressor.

A Dutch Motor Passenger Liner Fleet

Large Fast Ships for East Indies Trade Built and Now Building Employ Diesels Totaling Over 84,000 Hp.

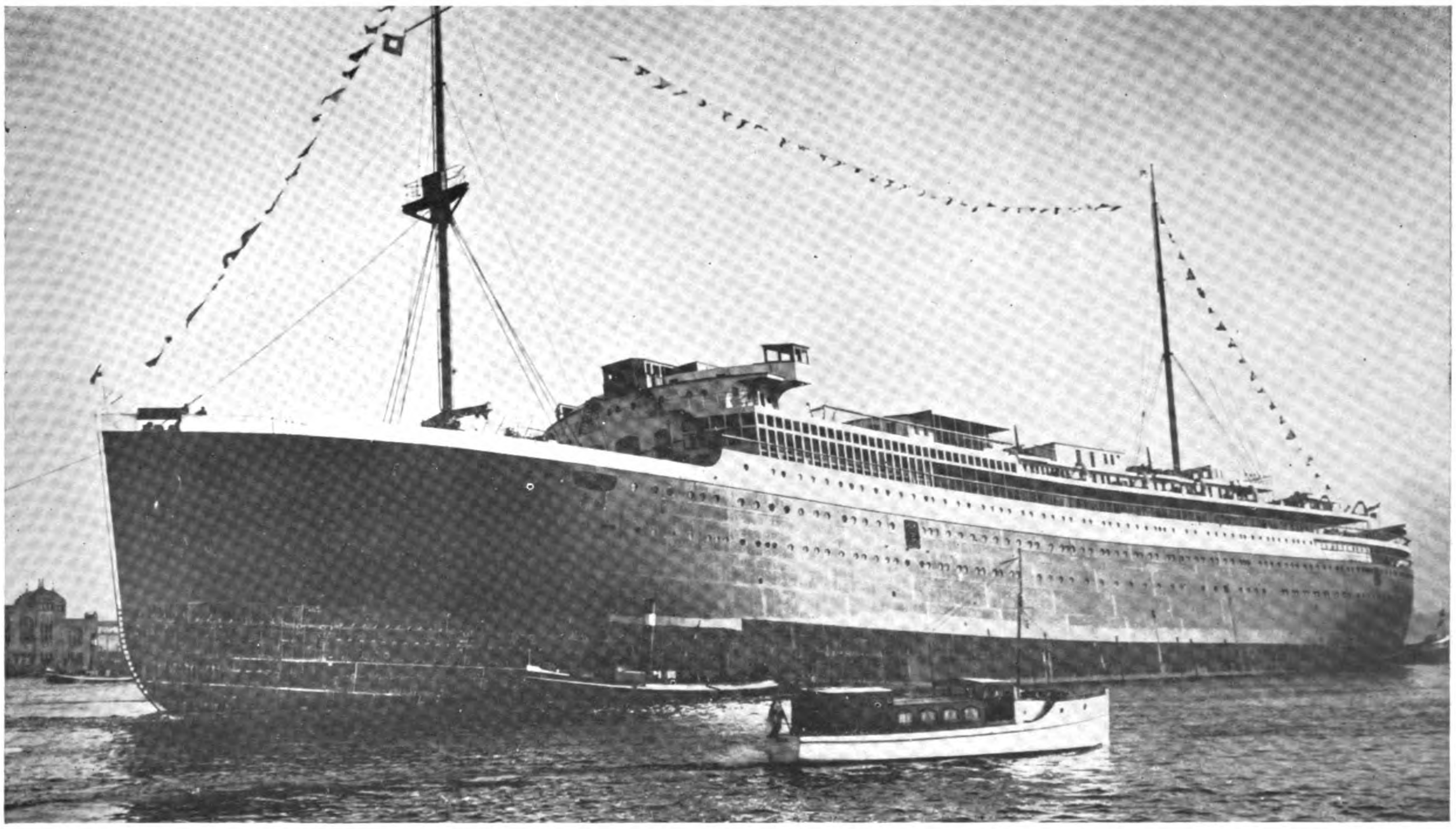
DUTCH services to the East Indies will within the next 2 or 3 years number among their operating units a fleet of fine passenger liners—all propelled by Diesel engines of the Sulzer type. There are two enterprising companies owning these ships—the Rotterdam Lloyd Ss. Co. and the Netherland Ss. Company, Amsterdam. The latter recently placed an order with Sulzer Bros. Winterthur, for a 10-cylinder single-acting Diesel of 760 mm. bore. The Netherland Shipbuilding Co., Amsterdam, will build two new hulls.

These ships will be of about 20,000 tons each. The main Diesels of one ship will be constructed by Sulzers at Winterthur, while Werkspoor will build the auxiliary Diesels. The De Schelde Co., Flushing, will construct the complete installation, both main and auxiliary motors, of the second vessel, fitting Schelde-Sulzer motors, the main Diesels being of 10-cylinder type. The first ship is to be ready within about 2 years, and the second 6 months later. The speed of the new ships will be about 18 knots. The main motors will be two ten-cylinder motors, developing together 14,000 h.p. The vessels will have accommodations for 620 first and second class passengers, 64 third class and 50 fourth class passengers.



French built Dutch motorliner P. C. Hooft of 10,500 hp. and 22,500 tons displacement

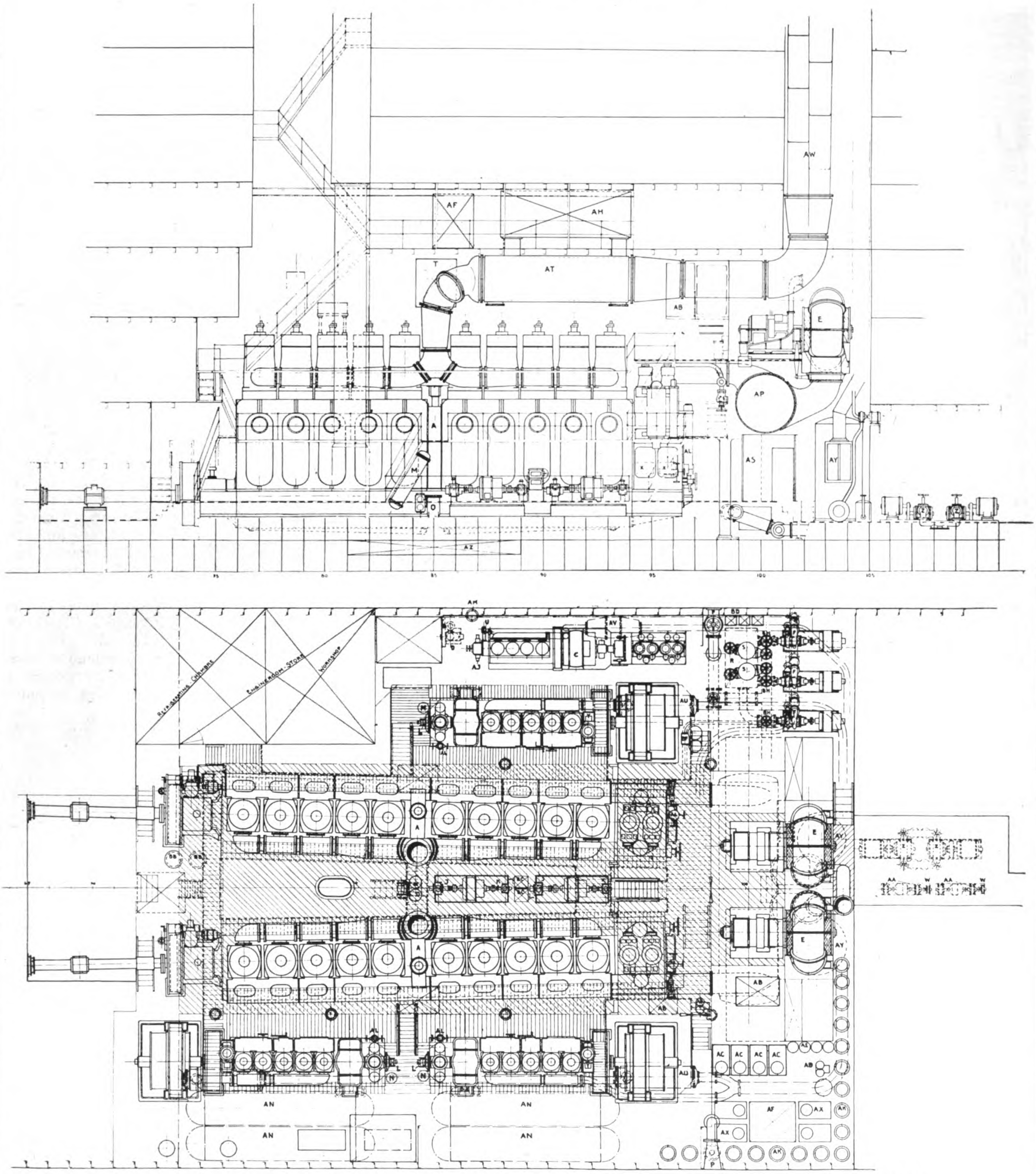
The Rotterdam Lloyd Co., has ordered two motor mail and passenger vessels from the De Schelde Company at Flushing. These ships will be about 18,000 tons each, and the hull of one of them will be constructed by the Feynoord Company at Rotterdam. The Rotterdam Lloyd Co. already owns two motorliners, the 10,772 gross tons INDRAPOERA and the newly commissioned 13,000 tons gross SIBAJAK. The Netherland Co. has the P. C. HOOFT. To all intents and purposes, the two companies co-operate in their policy of construction, as in the matter of freight and passenger



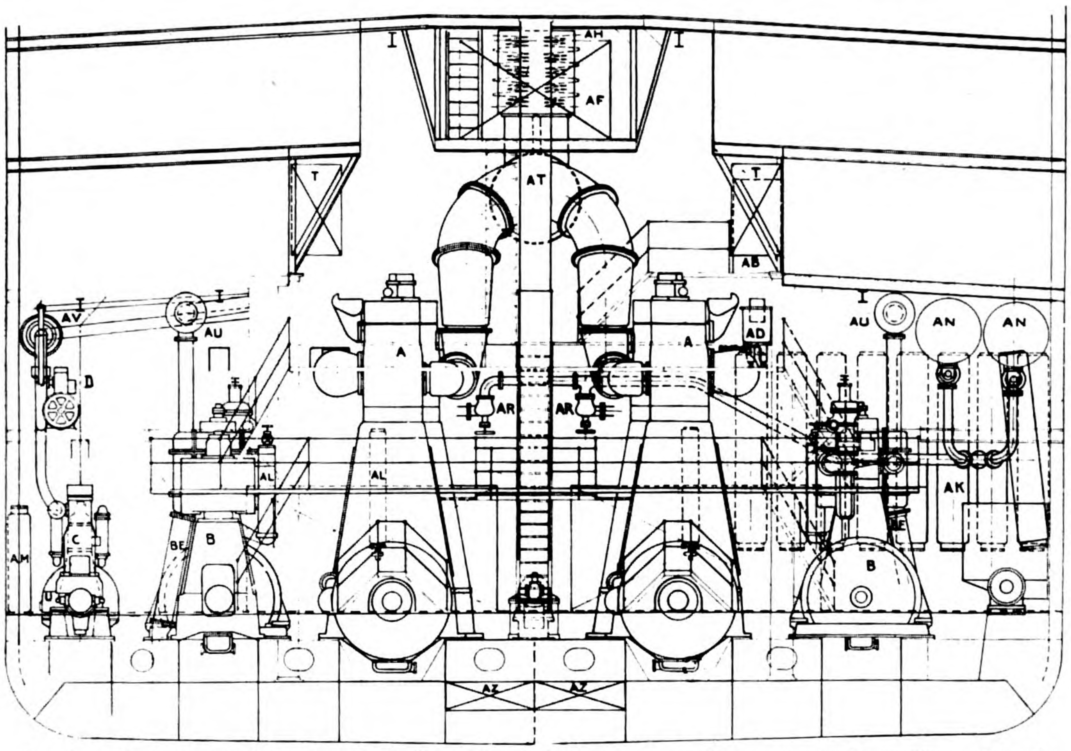
The big Dutch motorliner Christiaan Huygens, launched recently and now completing in Amsterdam, is one of a fleet of large ships built and building for Holland-Dutch East Indies service. They are all fitted with the same design of engines

Machinery Arrangement of the Dutch Motorliner Christiaan Huygens

11,600 B.Hp. with Two 10-Cylinder 2-Cycle Diesels



A Main Engines 10 St 68
B Auxiliary Engines 5 SS 38
C Aux. Compressor C 220 with 4 RK 30
D Aux. Compressor M C 6
E Turbo Blowers
F Cooling Water Pumps 270m³x2.5 At.
H Piston Cooling Water Pumps 78m³x5 Atm.
J Lub. Oil Pumps 90m³x2 Atm. for 10 St. 68
K Crosshead Lub. Oil Pumps 9m³x18 At. (10 St. 68)
L Lub. Oil Pumps For 5 SS 38
M Oil Cooler for Main Engines
N Oil Coolers for Auxiliary Engines
O Lub. Oil Strainers
P Seawater Inlet Valves
R Water Tank
S Water Strainers
T Warm Water Tanks
U Cooling Water Pump for 4 RK 30
V Water Tank for Fuel Oil Preheating
W Warm Water Circulation Pumps
X Fuel Oil Pumps of 10 St. 68
Y Fuel Oil Pumps of 5 SS 38
Z Fuel Oil Transfer Pumps
AA Fuel Oil Pumps
AB Fuel Oil Tanks
AC De Laval Separator for Fuel Oil
AD Fuel Oil Strainers
AE Fuel Oil Preheaters
AF Lub Oil Tank
AH Water Heater
AJ Fuel Oil Pumps of 4 RK 30
AK Starting Air Bottles 800 Ltr.x70 Atm.
AL Injection Air Bottles
AM Reserve Starting Air Bottle 245 Ltr.
AN Starting Air Tanks 8,500 Ltr.x28 At.
AP Scavenging Air Tank
AR Automatic Air Stop Valves
AS Switchboard
AT Silencer for Main Engines
AU Silencers for 5 SS 38
AV Silencer for 4 RK 30
AW Spark Arrestor
AX De Laval Separators for Lub. Oil
AY Boilers
AZ Double Bottom Oil Tanks
BB Bilge Pumps
BC Starters for Oil Pumps
BD Starters for Water Pumps
BE Air Suction Pipe for Scavenge Pumps
BF Piston Cooling Water Strainer
BH Shutoff Valve with Non Return Valve



Section through machinery of Ms. Christiaan Huygens, showing main and auxiliary Diesels

tariffs. It is of some importance to motorshipping, therefore, that two enterprising companies, controlling between them a large volume of trade to the Dutch East Indies, should be so thoroughly convinced of the potentialities of the Diesel engine for their work—to the exclusion of steamers.

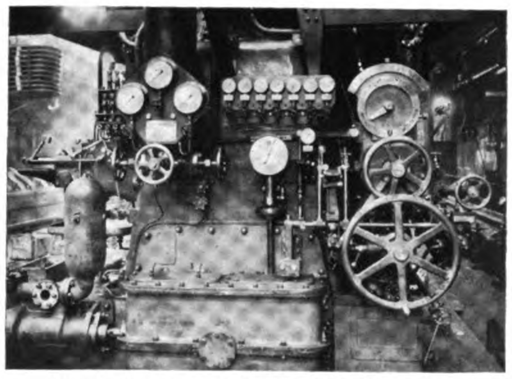
The P. C. HOOFT was the Netherland Co's. first motorliner. She is powered by two 8-cylinder 680 mm. x 1200 mm. Sulzer Diesels developing 10,500 total at 95 r.p.m. The Netherland Co's. second ship—Ms. CHRISTIAAN HUYGENS is completing in Amsterdam and is chiefly remarkable for the fact that she has two 10-cylinder 680 mm. x 1200 mm. Sulzer Diesels each developing 5800 hp. at 112 r.p.m. The total power is thus 11,600 hp. Cylinder liners and other main engine parts will thus be completely interchangeable for the two ships. This is an important point.

Each engine is fitted with two 3-stage air compressors of crosshead type. The camshaft drive is in the center of the engine, the manœuvring position being on the lower platform at the forward end of the engine. The fuel pumps are mounted on the compressor frames and are driven by links and levers from the compressor-crossheads. The single-collar thrust-block is mounted directly to the engine bedplate, which has proved to be a good arrangement to assure true alignment. The turning gear is electric. Both engines are arranged to exhaust into one common silencer.

Two electrically driven single-stage turbo-blowers are fitted, one being sufficiently large to supply both main engines with scavenge air, the second as standby.

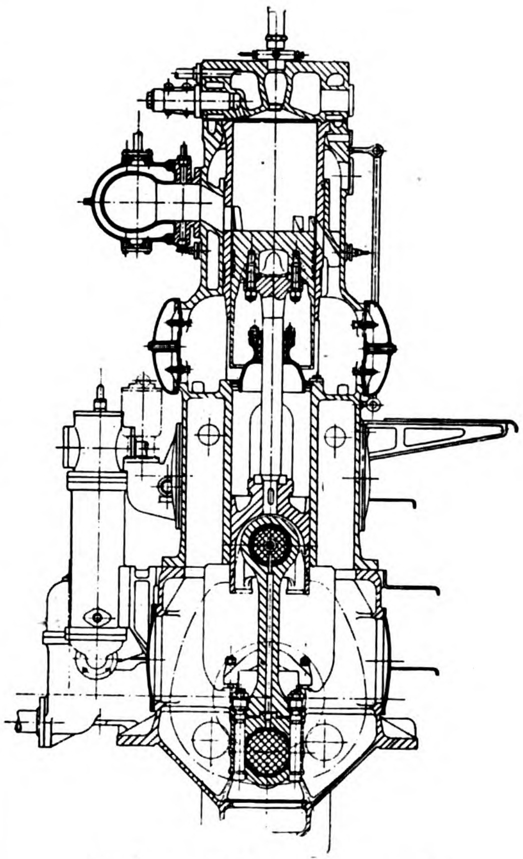
For cooling water supply three sets of combined electrical driven centrifugal pumps are fitted, one acting as a spare. The bearing and crosshead lubricating pumps are electrical driven gear pumps.

For manœuvring purposes 18 high pressure starting air bottles of 800 liters capacity for 70 kg/cm^2 pressure and four intermediate pressure tanks of 5000 liters capacity for 30 kg/cm^2 pressure are fitted.



Controls are at fore end of engines

The three auxiliary Diesels are also of Sulzer type coupled to generators and supplying current for all the auxiliaries.



Sulzer 6-cylinder standby engine

Each engine has 5 cylinders of 380 mm bore, 660 mm stroke and develops 650 b.hp. at 180 r.p.m. The engines are of crosshead-type, with scavenge pump and compressor, also of the crosshead type, driven from the main shaft. Ample auxiliary power has been provided, and the auxiliary engines are of slow running type, of the same design and speed as that adopted for main propelling engines of the same power, but with better governing devices and with no reverse gear. The emergency compressor-generator set (the plan shows a four cylinder motor which has been changed to a six cylinder) drives a smaller generator and through a clutch, which can be uncoupled, a 4-cylinder auxiliary compressor.

Comparative Sizes of Large Dutch Motor Passenger Liners

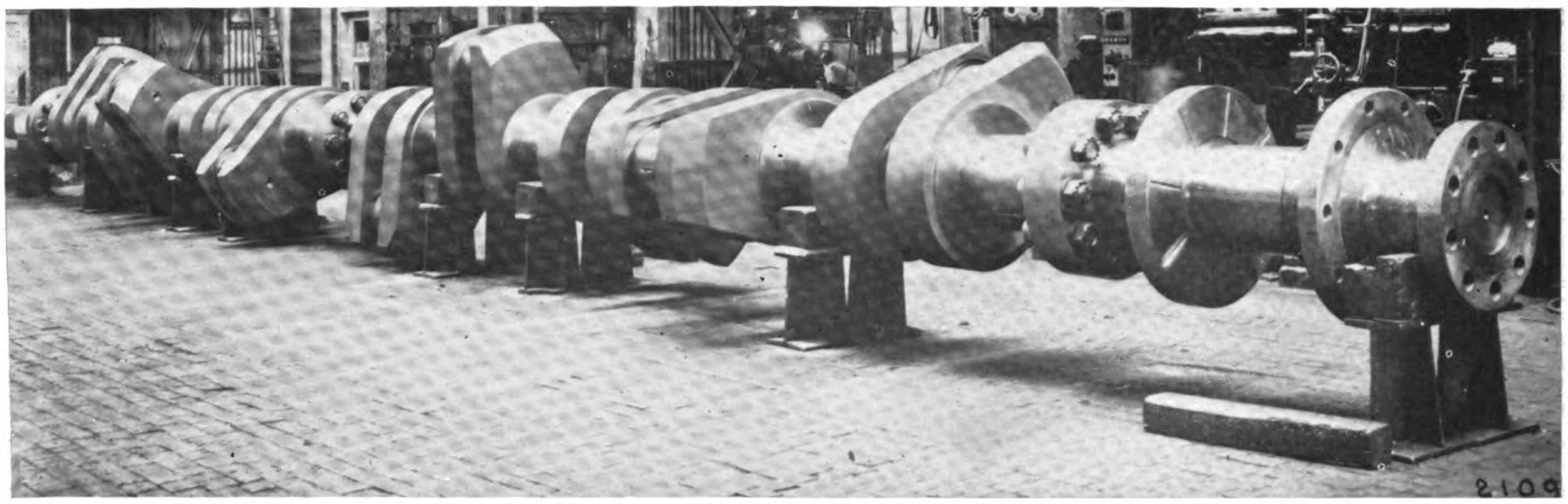
Name		Owners	Reg. Dims. Ft. L.	B.	D.	Tonnage	No. of Pass.
A	....	Netherland Ss. Co..	....	....	....	20,000	734
B	....	Netherland Ss. Co..	....	....	....	20,000	734
C	....	Rotterdam Lloyd....	....	....	....	18,000	...
D	....	Rotterdam Lloyd....	....	....	....	18,000	...
E	Christiaan Huygens..	Netherland Ss. Co..	550.0	68.5	39.7	16,000 G.	647
F	P. C. Hooft.........	Netherland Ss. Co...	540.0*	67.5	38.5	22,250 Disp.	639
G	Indrapoera	Rotterdam Lloyd....	500.0	60.0	38.0	11,500 G.	...
H	Sibajak	Rotterdam Lloyd....	530.0*	62.5	38.0	12,500 G.	464

All these ships in service from either Rotterdam or Amsterdam to the Dutch East Indies. Orders for A, B, C, & D have recently been placed.
* Length overall.

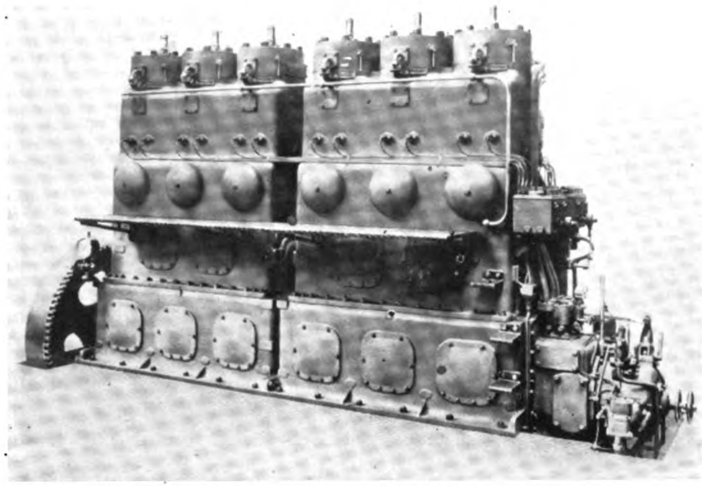
Comparative Machinery Sizes of Large Dutch Motor Passenger Liners

Name		Total Power	Speed	No. of Engs.	Ins. Bore	Ins. Stroke	R.P.M.	Type	No. of Cyls.
A	....	14,000 B.	18	2	30	....	...	2-cyc. S. A.	10
B	....	14,000 B.	18	2	30	....	...	2-cyc. S. A.	10
C	....	14,000 B.	..	2	30	....	...	2-cyc. S. A.	10
D	....	14,000 B.	..	2	30	....	...	2-cyc. S. A.	10
E	Christiaan Huygens.	11,600 B.	17	2	27.0	47.0	115	2-cyc. S. A.	10
F	P. C. Hooft........	10,500 I.	16	2	27.0	47.0	95	2-cyc. S. A.	8
G	Indrapoera	7,000 S.	15	2	30	53	87	2-cyc. S. A.	6
H	Sibajak	10,200 S.	16	2	30	53	85	2-cyc. S. A.	8

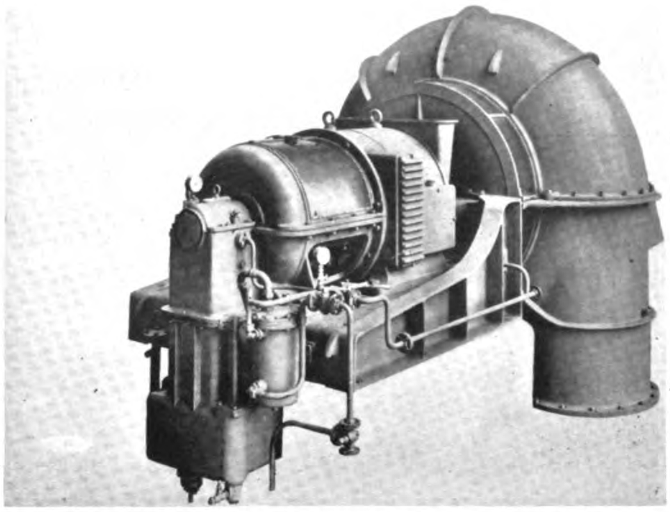
All the above ships have main engines 2-cycle single-acting Diesels of Sulzer type either built at Winterthur or through licenses of the Sulzer system.
This table takes no account of extensive motor cargo ship construction now being undertaken by the Rotterdam Lloyd Co.



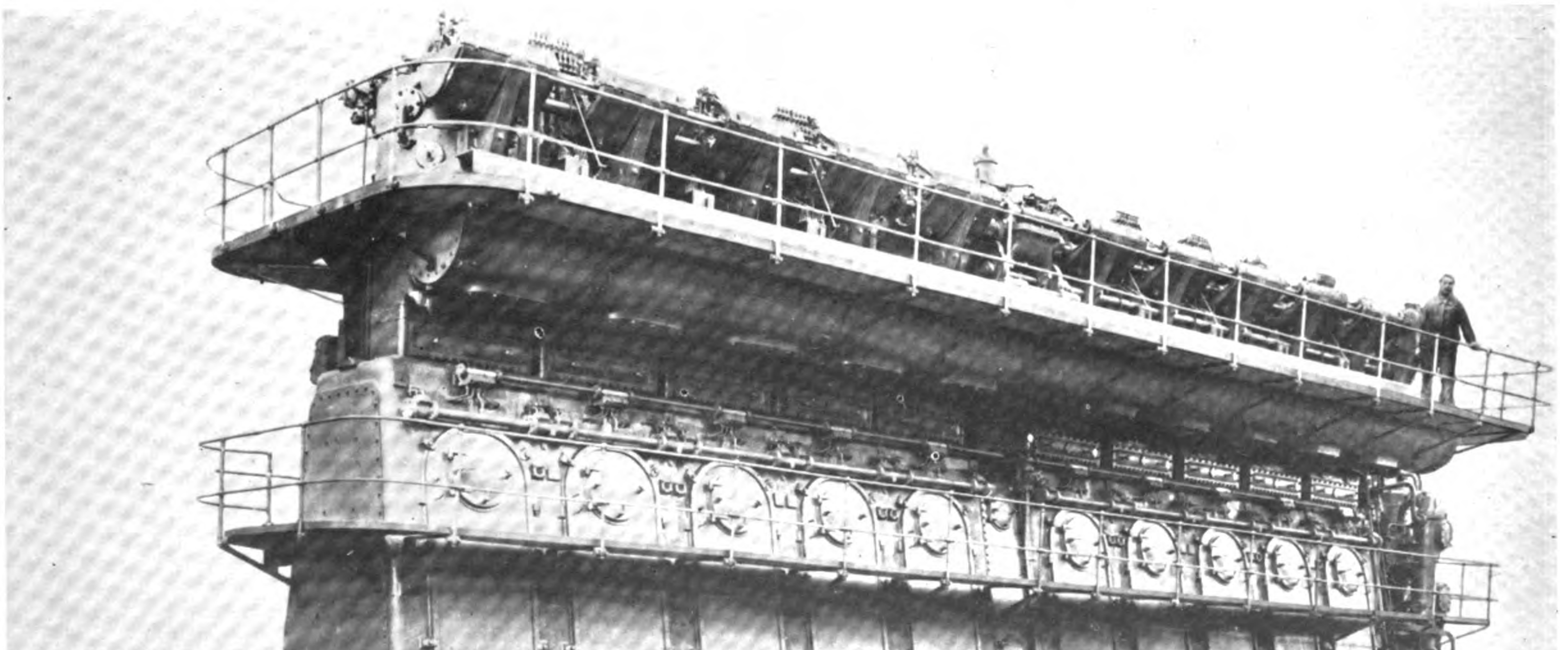
Crankshaft of one of the main 10-cylinder single-acting 2-cycle Diesels of the Dutch motorliner Christiaan Huygens



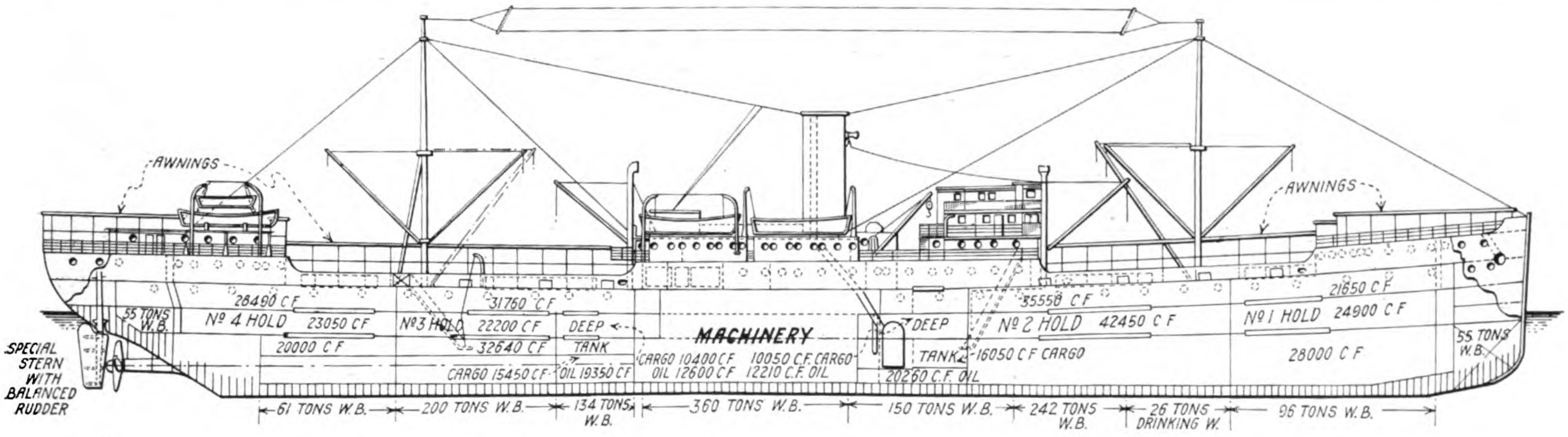
Six-cylinder 300 hp. standby Diesel of Sulzer type



Electrically driven scavenge blower for main engine



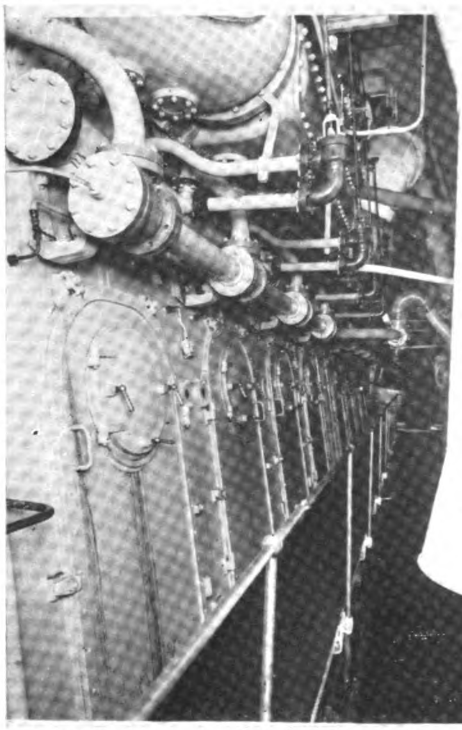
One of the two 10-cylinder single-acting 2-cycle Diesels, developing a bout 5800 hp., which powers the Dutch motorliner Christiaan Huygens



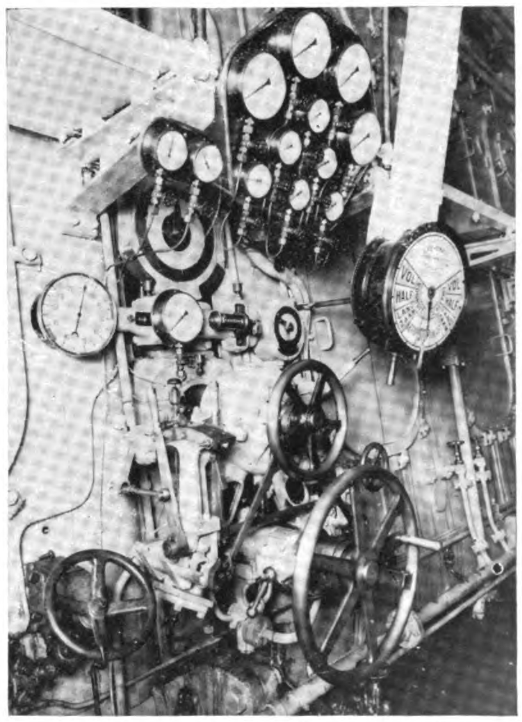
A Motorship Fleet for Dutch East Indies Service

THE single-screw motorship KOTJA RADJA is one of a fleet of Diesel engined cargo ships built for the Rotterdam Lloyd.

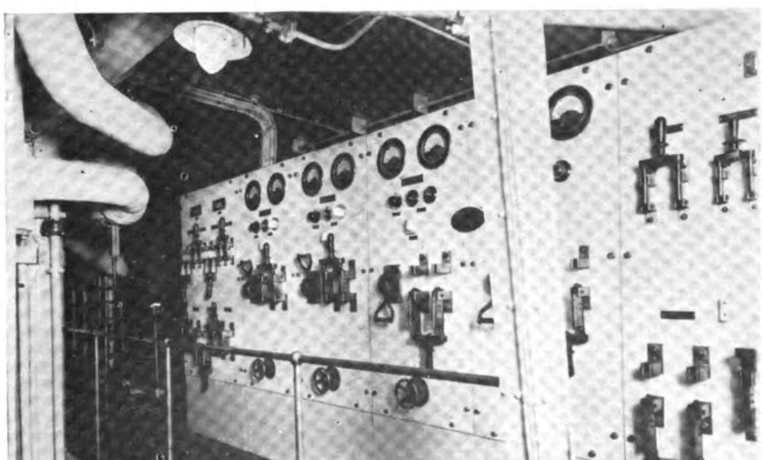
Ship and machinery have been built under special survey to the highest class of Lloyd's Register to designs of the builders completed in close co-operation with the owners and H. C. Weidenaar, superintendent engineer of the Rotterdam Lloyd. She has a mean speed of 14 knots and is one of the fastest motorships at sea. With short forecastle, poop and long bridge, and cruiser stern her length is 142.40m. overall and 136.74m. between perdendiculars, breath 18.45m., and depth to upperdeck 10.22m. On summer freeboard her deadweight capacity is 9,300 tons. Fuel oil bunkers will hold about 1,500 tons. Accommodation for Captain, Officers and Engineers is provided in deckhouses on bridge deck, crew's quarters are in forecastle and bridgedeck, and accommodation for twelve cabin-passengers is provided in deckhouse on bridge. Provision is being made for the carriage of a large number of pilgrims, powerful electric fans being fitted to the spaces reserved ror this accommodation. Watertight bulkheads divide the ship in nine compartments, of which two fore and aft of engineroom space are deeptanks, and each is subdivided in four oiltight compartments for the carriage of vegetable oils. Fifteen electric cargo-winches with derricks hung on posts ensuring maximum outboard reach and clear deck space, are fitted for handling cargo. Over two largest hatchways a 40 ton derrick can be rigged. Electric steering gear is fitted with telemotor control from the bridge, and there is an electric warping winch aft and electric windlass on forecastle. The main engine is an 8-cylinder 5,000 hp. Schelde-Sulzer Diesel running at 95 r.p.m. with scavenging pump and air compressor coupled direct to main shaft. The cylinders have a diameter of 760 mm. by a stroke of 1,340 mm. Engineroom auxiliaries are driven by electric motors, current being supplied at 220 volts by three generators each driven by a Schelde-Sulzer Diesel.



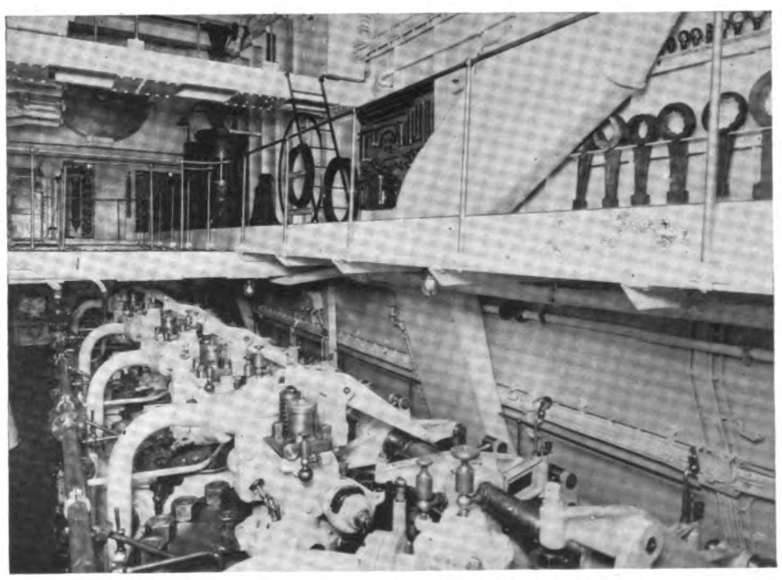
Outboard side of the main engine



Main engine control at bottom platform



Switchboard in main engine room



Cylinder tops of main 5000 hp. Sulzer Diesel

Fuel and Lubricating Oil Purification

SHOP tests on the main engines of the big Italian motorliner AUGUSTUS showed a power output for each engine of 9000-i.hp. at 125 r.p.m. with a consumption of 138 gr. per hp.hr. of fuel having a heat value of 10,000 calories, net. The total maximum output for the four main engines — 36,000-i.hp. — can propel the AUGUSTUS with her gross tonnage of 33,000, at a speed of 21 knots. In addition to the main motors there are three M.A.N. Savoia Diesels of 1200-i.hp. each and six of 600 i.hp. each in the auxiliary engine room.

Since the De Laval Purifiers, specified as part of the regular engine room equipment were available at the date set for the tests, it was thought advisable by N.G.I. technicians to lubricate and fuel the new Diesels with purified oil. This, beside making possible conditions which more nearly approached those under which the Diesels actually operate, insured accurate data and precluded many of the mechanical difficulties to which new motors, owing to their tight-fitting parts, and the presence of more or less fine core sand and metallic particles, are subject.

While it is seldom possible to measure the benefits derived from lubricating oil purification except after a comparatively long period of use, a reliable indication of the advantages of fuel oil purification was obtained while the engines of the MS. AUGUSTUS were running their tests. Samples of fuel were taken before and after purification and subsequent analysis showed the following characteristics:

	Before	After
Flash Point (Marcusson) ..	125 deg. C.	130 deg. C.
Viscosity (Engler) à 50 deg. C..	3.79	3.66
Heat value (Gross)	10,252	10,300
Water content.	0.4 per cent	0.1 per cent
Ash content ..	0.055 per cent	0.0025 per cent

The above figures are all the more remarkable in view of the fact that they were obtained during a shop test when, one must assume, the best and cleanest fuel obtainable was employed. Particularly noteworthy is the reduction of the ash content from 55/1000 per cent to 25/10000 per cent.

Three of the seven large capacity De Laval Purifiers specified for the AUGUSTUS are connected for the purification of lubricating oil, while the remaining four are used in the purification of fuel oil. Aside from the results shown in the shop tests, what may be expected of these machines under normal seagoing conditions can be pretty accurately predicted from past performances on other Diesel-driven ships. The chief engineer of a freighter plying between New York and Buenos Aires, for example, reports the removal of 211 pounds of dirt from his lubricating oil on a single trip. Another officer on a vessel, with an itinerary including ports in America, South America and Africa, states that De Lavals on his ship are centrifuging from 40 to 45 pounds of dirt from the system every 24 hours. Again the chief engineer of a Swedish vessel advises that De Lavals are removing 5 to 10 kg. of dirt every seven days.

In the matter of fuel oil purification similar results have been shown. The chief engineer of a Swedish vessel—the same one referred to above—reports that out of the 7½ tons of oil passing through the fuel oil purifiers every day, as much as 1800 kg. of water and solid matter have been removed. The improvement in valves and cylinders and the increased security of operation thus made possible is, the chief believes, too obvious to require comment.

It is the verdict of engineers generally that the combination of lubricating and fuel oil purification offers the only absolute means of insuring the full efficiency and economy of the Diesel engine. On this one point, at least, operators and builders are in agreement.

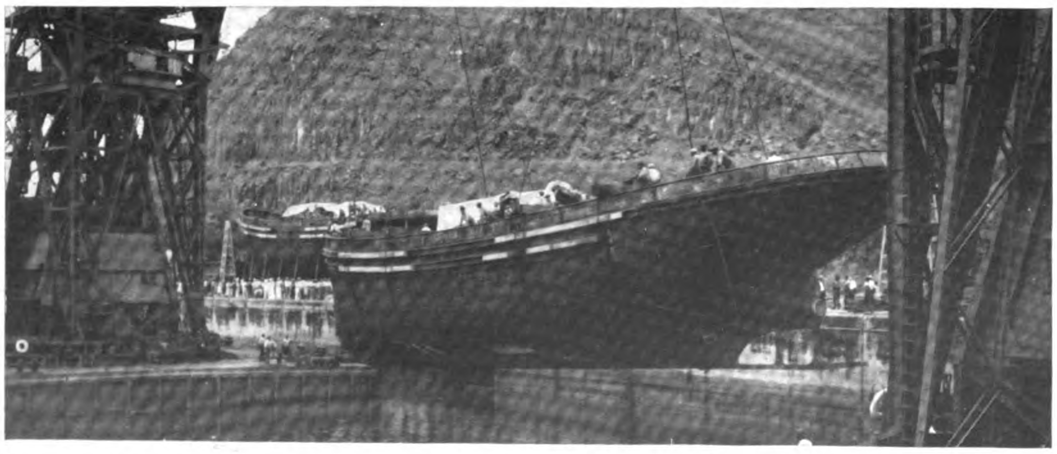
Diesel-Electric Tug Successful in Tests at Panama

THE Diesel-electric tug CHAGRES, completed by the Mechanical Division of the Canal Zone, passed a series of tests with great success during the latter part of December. Lieutenant Commander W. H. Hague, who was in general charge of the final trial trip, said that the tests were in every way satisfactory.

The *Star and Herald*, a daily newspaper of Panama, in reporting the event stated, in part, that, "Although not extended to its full power, the tug made 13½ knots in the trip from Pachea Island to Bona Island." A test at the dock, prior to the sea trials, showed a tow rope pull of 27,500 lb. This was about 25 per cent in excess of that expected. "The tests were declared to have been even more successful than engineers had hoped."

The CHAGRES and her sister tug, TRINIDAD, are the first Diesel-electric tugs to be built for service in the Canal Zone. These boats are the two largest Diesel-electric tow boats in the world, and the only craft of their type in Central and South America. Considerable interest was aroused recently in the method by which they were launched. Two huge floating cranes picked them bodily from the side of the drydock on which they were constructed, and placed them in the water.

Each boat is powered with two Ingersoll-Rand marine Diesel engines rated at 480 b.hp. Each engine is direct-connected to a generator and exciter. The power thus generated is supplied to a motor which drives the propeller. Electrical equipment was furnished by the General Electric Co.



Big Diesel-electric tug Chagres was built on the top side of the Balboa dry dock and lowered into the water by a floating crane

More than 30 people were aboard the CHAGRES during the final test. Among those who made observations on the trip were: R. P. Morgan, Foreman of the Marine Machinists, who was in charge of the Ingersoll-Rand Oil Engines; Mr. A. Ross, Superintendent of Erection and Tests, Ingersoll-Rand Company; Mr. Carrier of the General Electric Company; Mr. Hedges, who acted as chief observer; Lee Wood, Superintendent Engineer for the Royal Mail Steamship Packet; and Captain F. F. Stewart, Pilot at Cristobal.

Both the CHAGRES and the TRINIDAD are now ready for active service.

Our Supplements

Special attention of our readers is drawn to the two supplements, one descriptive of the big tanker MARY ELLEN O'NEIL and the other of the luxury yacht SAVARONA. These ships represent, each in its respective class, important contributions to the art of ship construction and, with the cooperation of everyone concerned in their construction we have treated them in very considerable detail.

U. S. Shipping Legislation

As we go to press we have received a copy of an important bill No. H.R. 10765 which has been introduced in the House of Representatives by Mr. Wallace H. White. This bill is of a distinctly constructive nature and is one of the most important shipping legislature measures we have yet examined.

Diesel Driven Pushboat Tornado

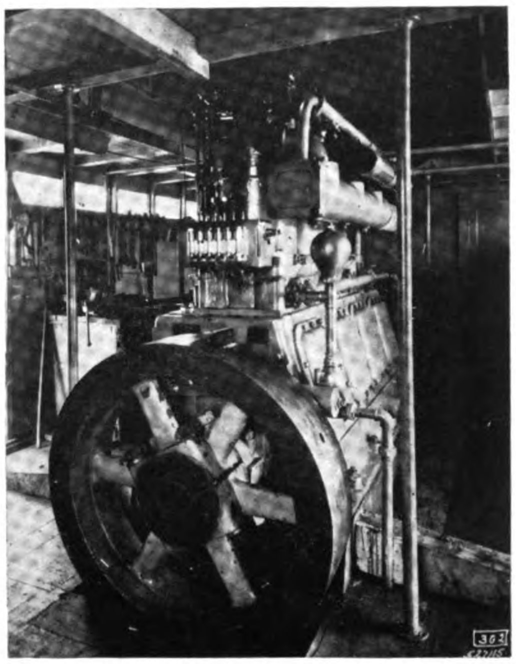
THE Western River towboat or "pushboat" TORNADO was built in 1925. The original engine was a gasoline motor, belt driving the wheel through tight and loose pulleys. This engine was replaced by a 110 i.hp. 3-cylinder Bessemer Diesel placed fore and aft with a 3 5/16 in. drive shaft running back to a gear box of Mr. Zubik's (the owner) own design which he had built by the Marine Manufacturing & Supply Company, Pittsburgh.

This is of simple construction, and consists of an 18-tooth pinion meshing with a 54-tooth ring gear. The gear box has two bearings for the jack shaft which runs clear through it the entire width of the boat so that the sprockets can be put on either end of it. However, it is connected up with only one pair of sprockets and chain. The small sprocket on the jack shaft has 15 teeth and the large sprocket on the paddle wheel has 46 teeth, giving a reduction of 9.2 so that when the engine is turned at its rated speed of 300 r.p.m. the main propelling wheel aft turns at 32.6 r.p.m.

The wheel is 13 ft. long x 11 ft. 2 in. in diameter with twelve 16 in. buckets. Originally the wheel was 11½ ft. in diameter with 18 in. buckets but the owner took off 2 in. from each bucket or a total of 4 in. off the diameter, thus reducing the wheel to 11 ft. 2 in.

The boat is registered as 24 tons and is used entirely for towing purposes, hauling sand and coal barges, scows, flats, etc.

Western river boat Tornado, whose efficiency has been improved by the fitting of a Diesel



Three cylinder 110 hp. Bessemer Diesel drives Ms. Tornado

Electric Freighters Defiance and Triumph

AWARD of contract to the Westinghouse Electric and Manufacturing Company for the complete electrical equipment of the Shipping Board freighters DEFIANCE and TRIUMPH, which will be converted to Diesel-electric drive, is now announced. The DEFIANCE will be converted at the Norfolk Navy Yard, and the TRIUMPH at the Boston Navy Yard. A third ship, the COURAGEOUS, as we have already announced is being converted at the Federal Shipbuilding Co.'s plant, Kearny, N. J. She will have General Electric equipment.

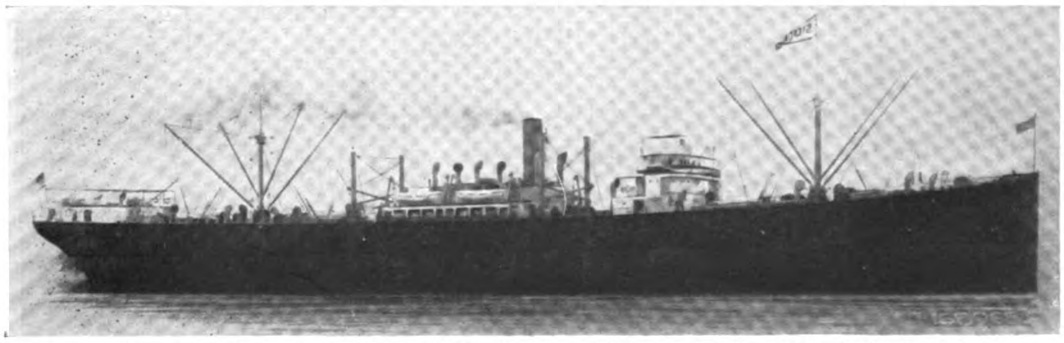
The vessels are having their present 3000 hp. steam propelling machinery and steam auxiliaries removed, and 4000 s.hp. Diesel-electric propelling machinery with complete electric auxiliaries installed. Diesel power on each ship is furnished by four McIntosh & Seymour engines. This increase in the propulsive horsepower, with changes to be made in the bow and stern of the vessels to improve their lines, and a new propeller designed for 60 r.p.m., is expected to give the freighters a speed in excess of 13 knots, as compared with their former speed of 10½ knots. Plans and specifications for the conversions were prepared by Gibbs Bros. Inc., of New York, with the cooperation of Admiral D. W. Taylor.

The Westinghouse company states that electric propulsion was decided upon in preference to a direct Diesel drive, largely because of the saving in cost, weight and space in favor of the electric drive where comparatively low propeller revolutions are desired. Careful comparative studies of the electric and direct drive forms of propulsion showed that, in the case of these particular ships, many advantages would be derived not only in the installation, but also in operating features of the vessels.

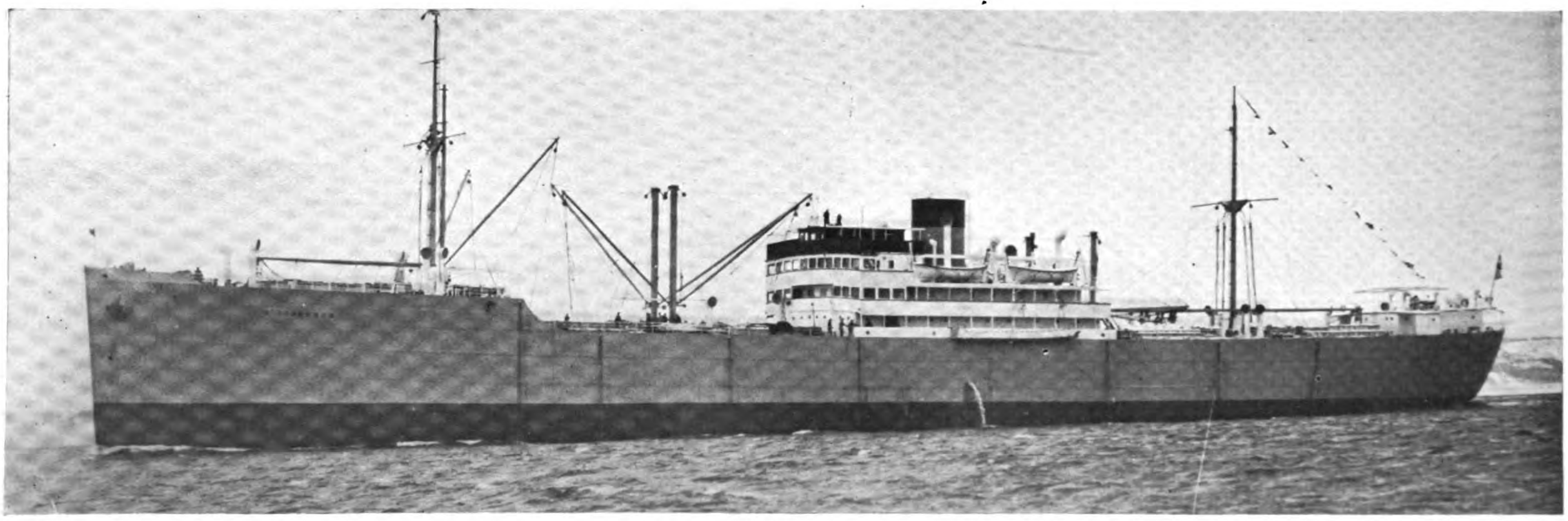
The vessels will be driven by a 1500 volt double armature, direct current, forced ventilated motor of 4000 s.hp. at 60 r.p.m., direct connected to the propeller. Power for the propulsion motor will be supplied by four main generator sets, each of which comprises a McIntosh-Seymour Diesel engine, directly connected to an 800 kw. 250 r.p.m., 385 volt main generator and a 100 kw., 240 volt direct current auxiliary generator and exciter.

The Westinghouse variable voltage propulsion control equipment will be installed with dead front control panels and arranged for both pilot house and engine room control.

All deck auxiliary machinery will be electrically driven and will consist of one warping and twelve deck winch water-proof motors of 25 hp., and one water-tight anchor windlass motor of 65 hp. The magnetic brakes and master controllers of the deck motors are all of water-proof construction.



Shipping Board freighters of the Defiance class are being Diesel-electrified



Swedish 15 Knot Passenger Cargo Motorship

Ms. Mirrabooka, Now on Maiden Trip to Australia via Panama, Built for Fast Wool Transportation Trade

THE fast cargo and passenger motorship MIRRABOOKA, sailed on her maiden voyage from Gothenburg for Los Angeles via the Panama Canal on January 21.

Ms. MIRRABOOKA is a combination passenger and freight vessel, recently completed and with her two Gotaverken B. & W. Diesel engines, developing 6400 i.hp., is capable of a service speed of 15 knots.

Her passenger facilities accommodate thirty and are elegantly furnished, including several cabins with bathrooms, a large dining room, a ladies' parlor, a smoking room and bar. Part of the promenade deck is entirely enclosed and a substantial space is reserved on the boat deck for the comfort of passengers.

Her first voyage will be around the world, and is sponsored by the Swedish Weekly "Veckojornalen." From Los Angeles, where she takes on general cargo, she will proceed to Brisbane, reaching this destination in 17 days; thence to Sydney, Melbourne, Perth, Colombo, Aden and Naples, returning to Gothenburg.

While this vessel has been built primarily for the wool trade between Australia and Europe, it is anticipated that she will be frequently seen on the Pacific Coast in the off season, when she will be engaged in the service of the California-Australia direct line of the Transatlantic Steamship Company, whose vessels are managed on this coast by the General Steamship Corporation. Other motorships engaged in this service are the Ms. BULLAREN, Ms. EKNAREN, Ms. TISNAREN, Ms. YNGAREN. This fleet affords monthly sailings direct to the principal ports in Australia, carrying substantial cargoes and numerous passengers.

Characteristics of Ms. Mirrabooka

Length overall	457 ft. 0 in.
Length b.p.	435 ft. 0 in.
Beam	57 ft. 0 in.
Depth molded to main dk.	30 ft. 10 in.
Depth molded to shelter dk.	39 ft. 10 in.
Draught (load)	26 ft. 7 in.
Service speed	15 knots
Output of main engines	6.400 i.hp.

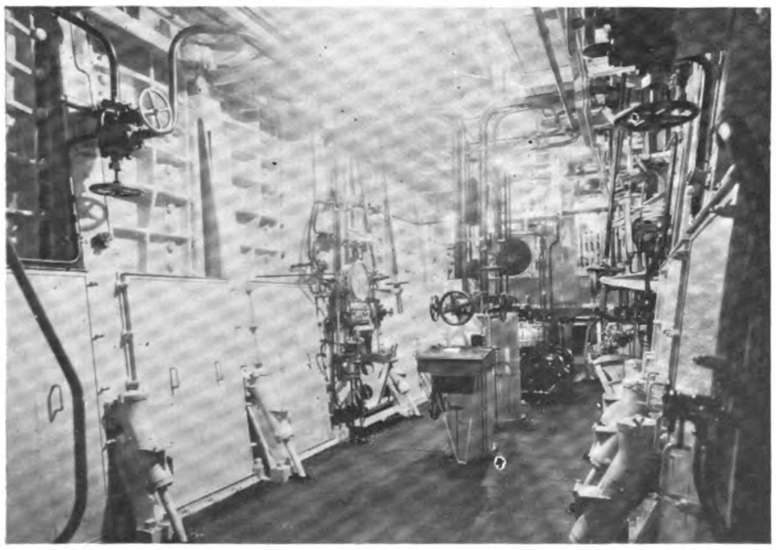
Ms. MIRRABOOKA is the first of the two 15-knot highclass motorfreighters constructed at Götaverken, Gothenburg, for the Transatlantic Steamship Co. The ship as has been mentioned, is mainly intended for cargo-carrying service from Europe to Australia and the Far East. Her service speed of 15 knots, is claimed to make her the fastest cargo ship out of Sweden. On the trial trip in ballast a main speed of not less than 16.7 knots was obtained.

Eight watertight bulkheads divide the ship into nine compartments which respectively from forward are the fore peak tank, three holds, the machinery compartment, two holds, the after peak tank and stores.

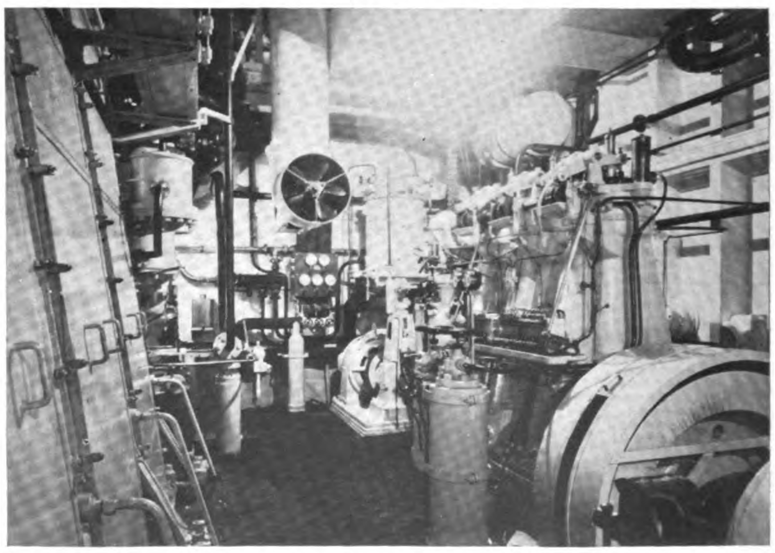
In the after peak tank fresh water is carried. Water ballast or oil fuel is carried in eight double bottom tanks extending all over the ship's length between the peak tanks and in wingtanks totaling an oil fuel bunkering capacity of about 2000 tons.

She has an open shelterdeck, a maindeck and forward of the motor room a second deck. The five hatches, 27 ft. to 32 ft. in length are operated by 14 electric Swedish General Electric winches.

The after end of the maindeck is devoted



Control positions on Gotaverken B. & W. 3200 hp. (each) Diesels



Corner of engine room, showing one of the auxiliary generator sets

to crew's space, accommodation being here provided for 14 seamen and 12 motormen.

Airy and comfortable accommodations for captain and officers are arranged in the one house amidships, the captain's flat being located on the boatdeck and officers' cabins on the shelterdeck. Between these decks on the promenade deck accommodation for twenty passengers in two-berth cabins is provided, two of which are luxury-cabins having a separate bath-room.

Five cabins are arranged at each side of the house, the central fore part being arranged as a dining hall, framed and panelled in dark birch with columns also in dark birch.

A lounge with panels in grey maple, is arranged at the port side of the dining hall with a restful smoke-room upstairs. The latter is panelled in dark oak, decorated with many very finely executed paintings.


Smoking room of Ms. Mirrabooka

Suitable big bath-rooms, etc. are arranged in convenient proximity to the cabins.

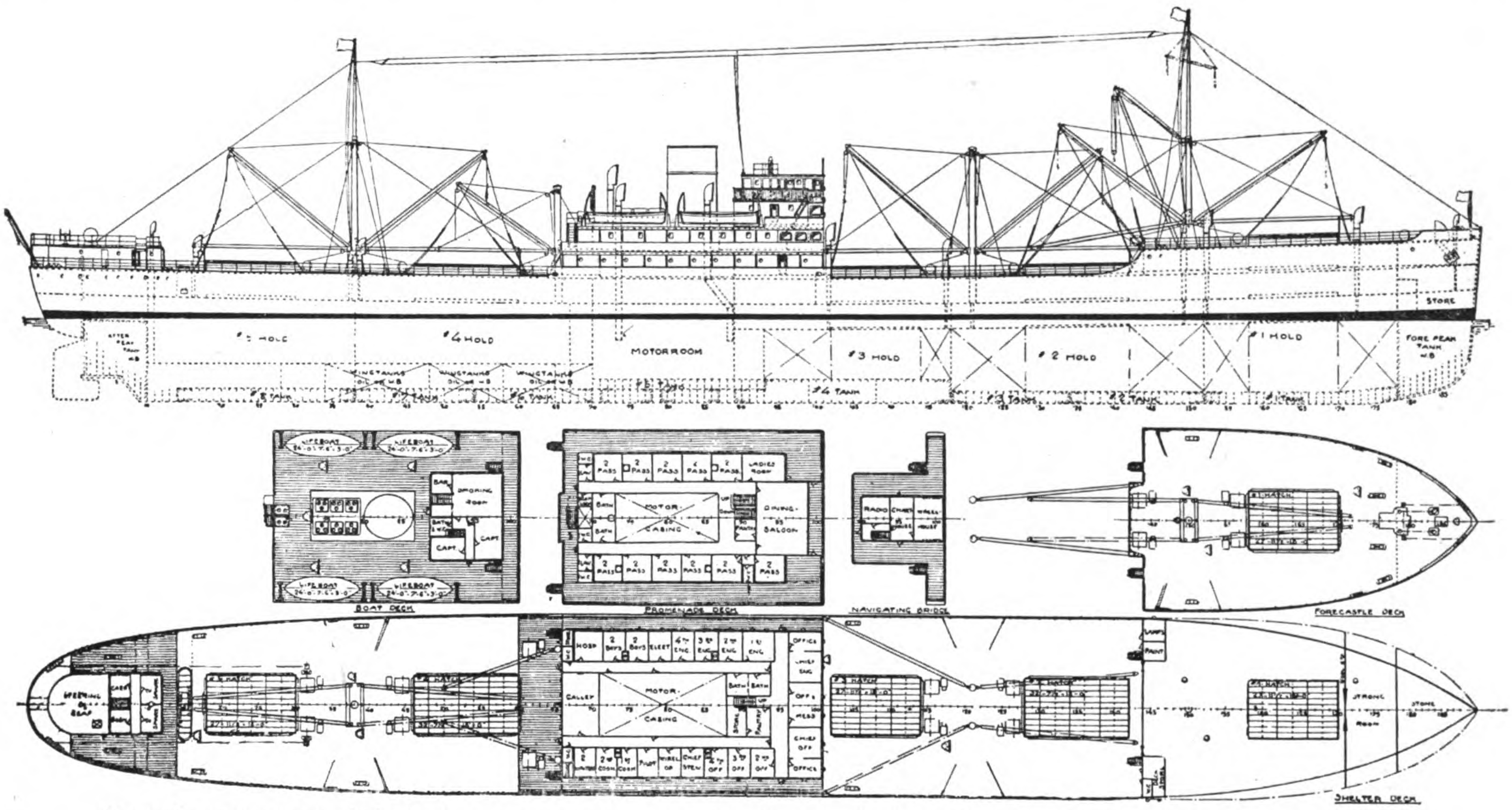
Ample ventilation is provided for in all living spaces, with electric fans for passengers and officers.

The refrigerating plant and cold storage rooms are amply dimensioned with separate refrigerating rooms for meat and fish.

The propelling machinery consists of two Götaverken B. & W. 6-cylinder motors designed for an output of 3200 i.hp. each at 110 r.p.m.

All the auxiliary machinery is electrically driven and there are, for supplying the necessary current, three generators, totaling 266 kw. Centrifuges are provided for both lubricating oil and oil fuel.

The first voyage, a round the world trip from Sweden via the Panama Canal to Australia and home all passenger berths are booked by a leading Swedish weekly illustrated paper. The MIRRABOOKA is a fine example of a fast modern motorship.



General arrangement of the fast passenger and cargo motorship Mirrabooka, built for service in the Australian wool trade

German Motorship for Pacific Coast

The motorship HEIDELBURG of the Hamburg-American Line, formerly the DUISBURG, has been taken off the Hamburg-Australia run and placed in the European-Pacific Coast Service, beginning with the Westbound sailing from Hamburg, February 18th; from Antwerp, February 25th. She is due to arrive at Los Angeles March 24th, and at San Francisco, March 28th.

MS. HEIDELBURG is a 10,000 ton dw. freight motorship propelled by two 8-cylinder M.A.N. 4-cycle Diesels developing collectively 4000 hp. and driving a single screw through Vulcan-Foettinger reduction gearing. She has cabin accommodations for 20 passengers. She has a speed of 13 knots, and will make the trip from Hamburg to Los Angeles in 33 days; to San Francisco in 35 days.

In addition to ten 2-berth outside state rooms, there are a comfortably furnished dining room and a smoking room. All these accommodations are attractively furnished and equipped with modern conveniences. The deck space allotted to the passengers provides ample room for promenading and deck sports.

Other motorships scheduled for the Line's European-Pacific Coast Service are the ODENWALD, and four new motorships now under construction, the SAN FRANCISCO, LOS ANGELES, SEATTLE and PORTLAND.

The Texas Company, through a stock exchange, is to acquire the assets of the California Petroleum Corp. and the resultant organization will have oil properties with an aggregate asset value of over $530,000,000, thus becoming one of the largest units in the industry. Upon completion of the consolidation a program of expansion is planned especially for the Far East as the California Corp.'s production of crude oil on the Pacific Coast is just about what the Texas Co. needs to fill its deficiency in production for the Far East trade.

Ms. Wm. Penn

MS. WILLIAM PENN, operated for Shipping Board account by Roosevelt Steamship Co., recently completed a round voyage of 34,681 miles at an average speed of 11.22 knots. The vessel brought 12,500 tons of miscellaneous cargo including ore, rugs and spices from India. On her outward voyage from New York and the Gulf WILLIAM PENN called at Australian ports where she loaded 400 horses for India. Only two of these animals died enroute while the average number of casualties for years has been 17. MS. WILLIAM PENN will take 5500 tons of sulphur to Australian ports next month besides other cargo.

New Diesel-Electric Ferry

Bids have been opened for a Diesel-electric ferry for the Norfolk County Ferries, Portsmouth, Va. Eleven Diesel manufacturers submitted bids. The new vessel will have two 400 hp. Diesels.

High Piston Speed Diesel Engines

New Developments Indicate Widening of Field of the Marine Diesel Engine for Small Fast Craft of Yacht Type

By Elmer G. Griese

ONLY a short time ago, the popular conception of a Diesel engine was that of an elaborate and complicated piece of mechanism which could be operated only by the most skilled mechanics, and was quite beyond the hopes of the average yachtsman unless he was in position to employ the services of a trained engineer. Diesel manufacturers interested in this field are now beginning to make every effort to simplify design, to reduce noise and vibration, eliminate smoke and obnoxious odors, and, what is probably the most interesting of all, to bring the design to a size and type that lends itself to economical manufacture and consequently lower first costs. In passing, however, we may note that outside the pure pleasure boat field the potentialities of the Diesel for small craft has long been realized by countries like Holland and Belgium with immense inland waterway fleets. Small Diesels are almost as numerous, for workboats, as gasoline engines.

At the recent Motorboat Show held in the Grand Central Palace in New York City, several manufacturers displayed a Diesel engine which compared most favorably with existing gasoline engines, in finish, accessibility, and particularly in simplicity of operation and maintenance. Diesel manufacturers are adopting the experience of the automotive manufacturers to their own work. Production methods are being employed, and with the promise of an increasing volume of business it will be but a short time before the difference in first cost of the Diesel and the gasoline engine will be very slight, assuming, of course, that the same construction, workmanship and material exists in either case.

The matter of vibration is of particular interest when the engine is to be used in a pleasure boat, and this probably has been one of the most serious problems with which the Diesel manufacturer has been compelled to cope, and it has not always been the fault of the engine manufacturer that vibration exists in a yacht. Quite frequently it is due to conditions of installation over which the engine manufacturer has no control. However, the engine manufacturer, architect and yacht-builder are working closely together, and the yachts recently built are remarkably free from vibration.

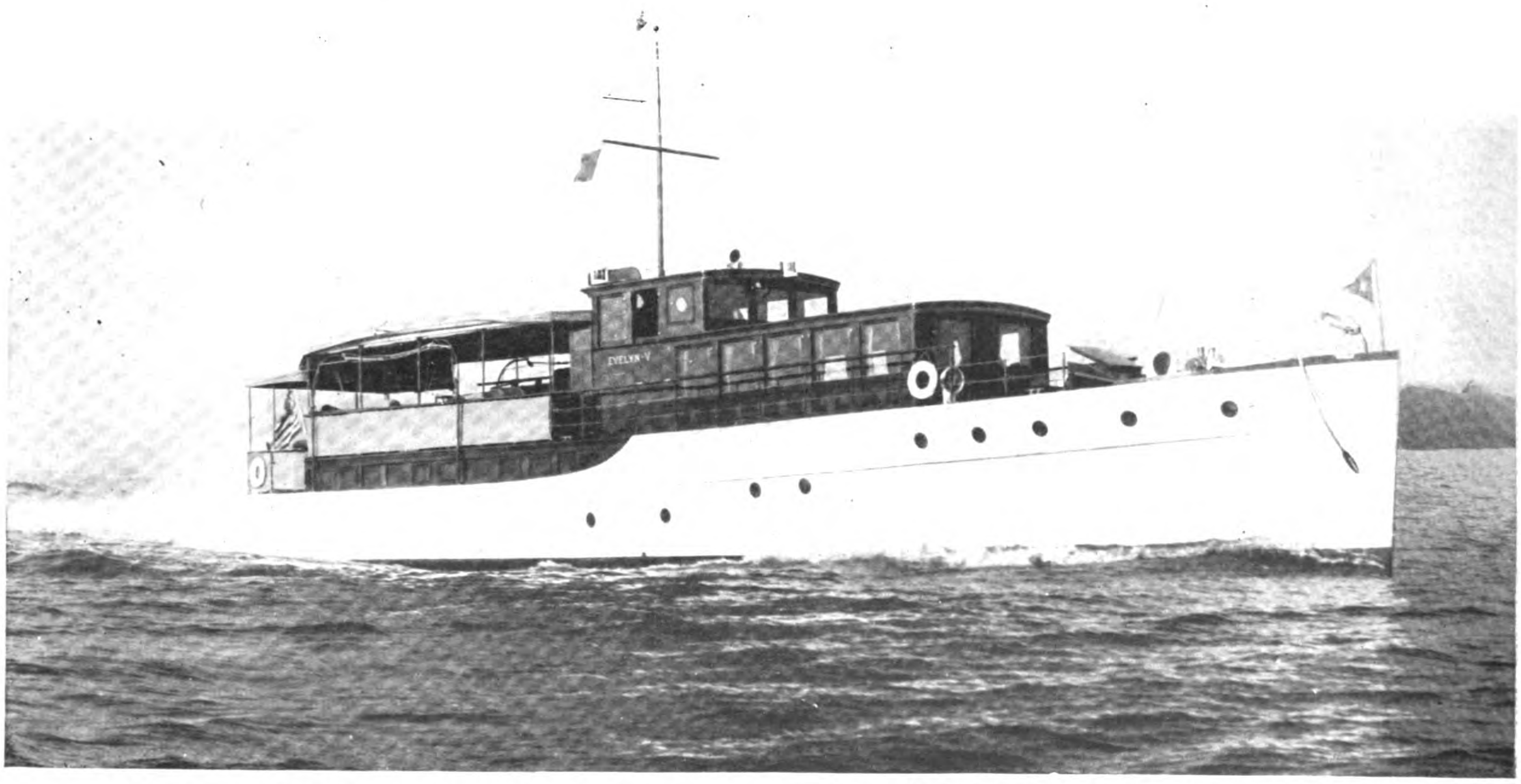
Mr. C. L. Cummins, the inventor of the Cummins Injection Principle, for Diesel engines, has gone a long way towards elimination of vibration caused by irregular combustion. It must be realized that no matter how well an engine may be in balance mechanically, if it has a variation of combustion pressure the engine will vibrate.

Higher piston-speeds are being rapidly accepted by the trade, as in this type of engine the owner secures greater mechanical efficiency, more power per weight of engine, economy of space, and can use a type of engine which better lends itself to manufacture and easy replacement of repair parts. When a lower propeller-speed is desired, reduction gears have been developed and can be used with a power loss of not over one and one-half percent.

The development of high piston-speed engines requires a rapid burning of the fuel, as the time element for fuel preparation is increasingly short as the piston speed goes up. It is this fact which makes so important the Cummins' injection principle.

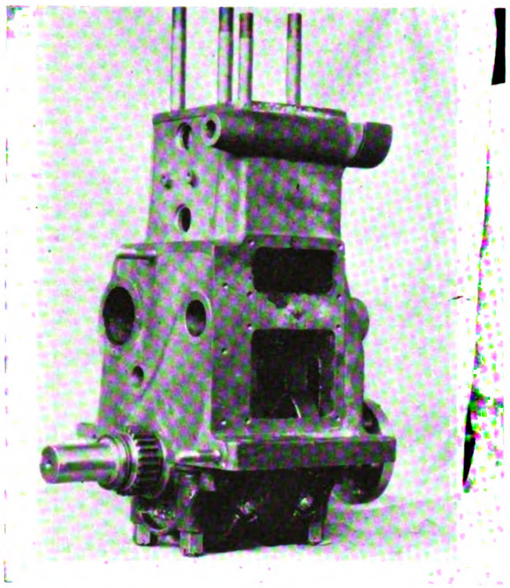
In this principle, which cannot be termed airless injection, Mr. Cummins uses the available characteristics of the Diesel principle; namely, the generation of heat as the result of high compression. This heat is applied to the fuel in advance of its injection into the cylinder, and in this respect it differs widely from the conventional type of airless injection Diesel. This is, briefly, the principle. There are many advantages obtained by the method in which this is accomplished.

The fuel oil is delivered to this injection mechanism under very low pressure, and

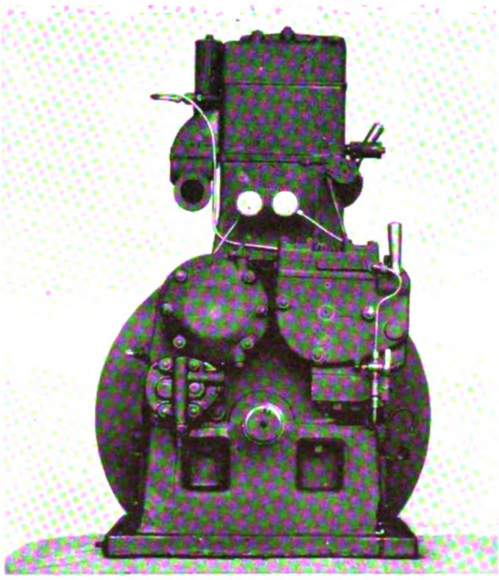


The motoryacht Evelyn V is typical of the fast pleasure craft type which high speed Diesel engines are now serving

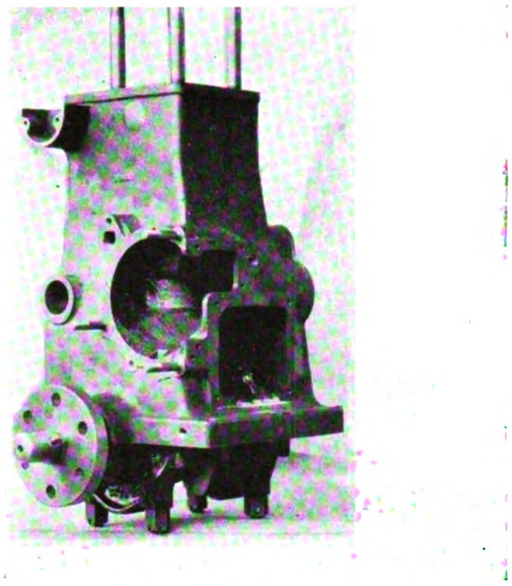
The Cummins Diesel—A High Speed Yacht and Workboat Type



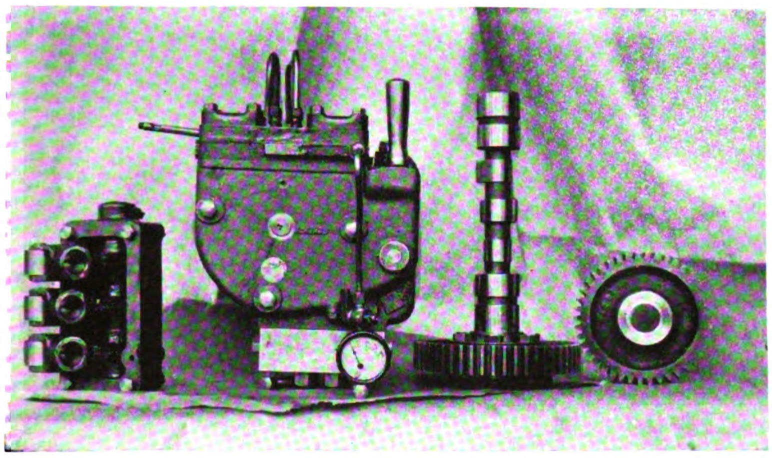
Crankcase and cylinder jacket



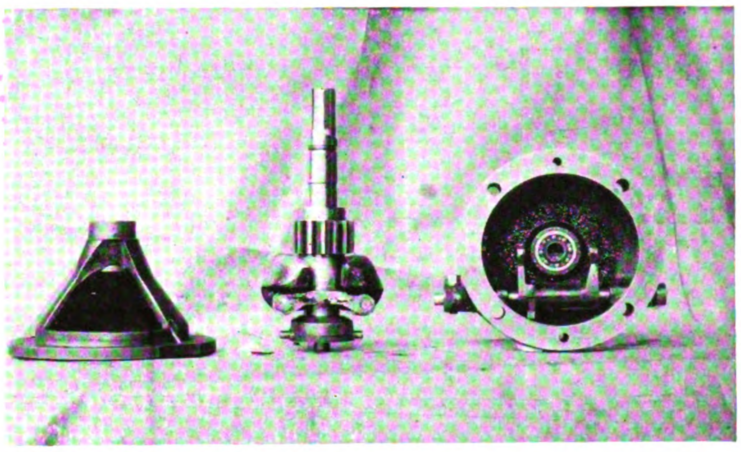
End view, showing fuel pumps



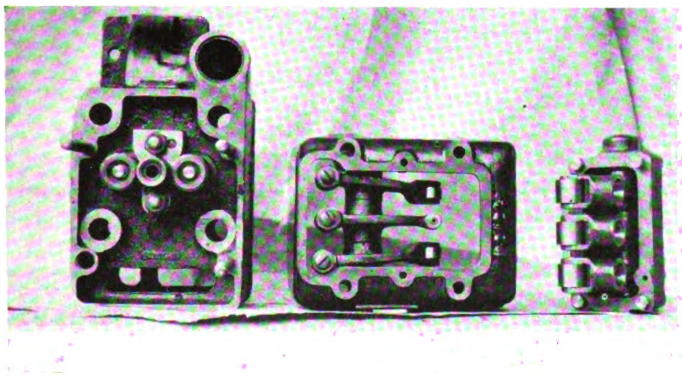
Another view of cylinder casting



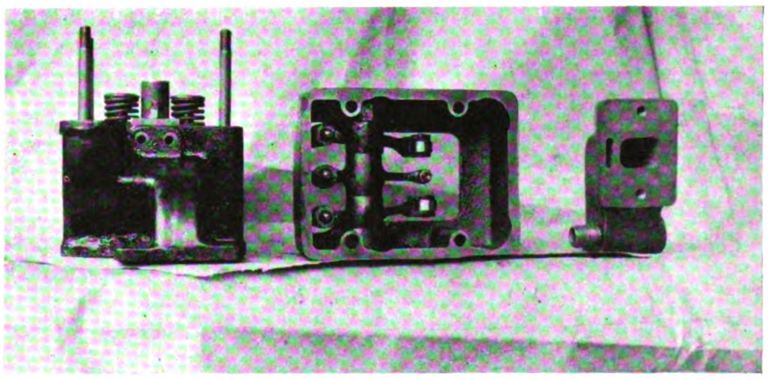
Fuel pump assembly



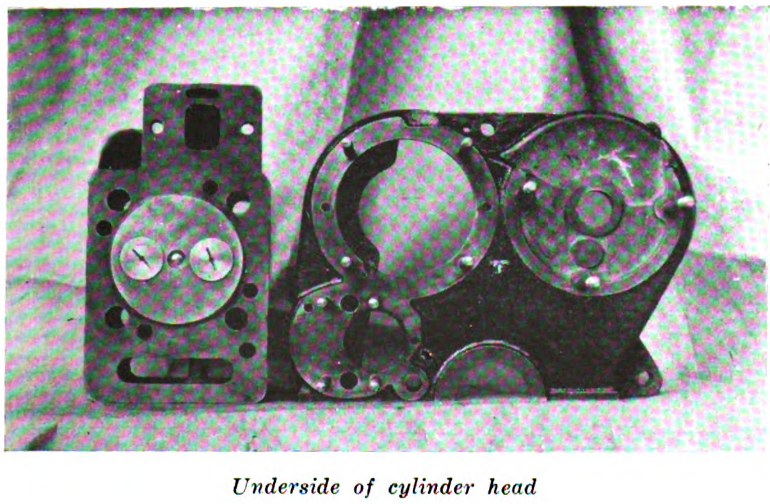
Governor gear



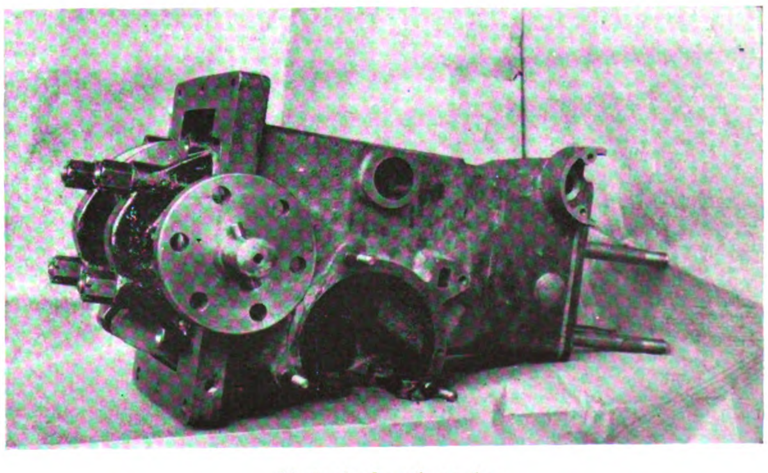
Cylinder head and rocker arm assembly



Side view of cylinder head and valve gear

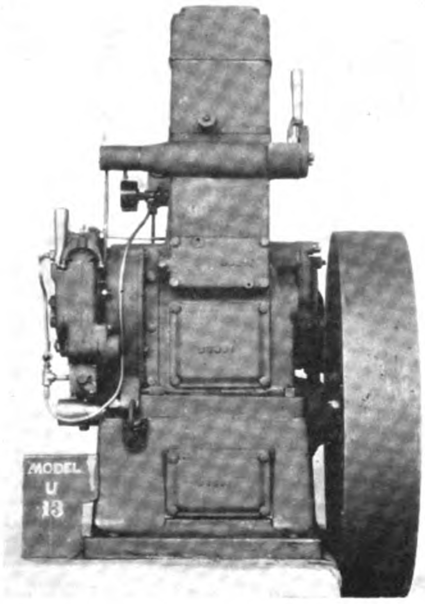


Underside of cylinder head



Main body of engine

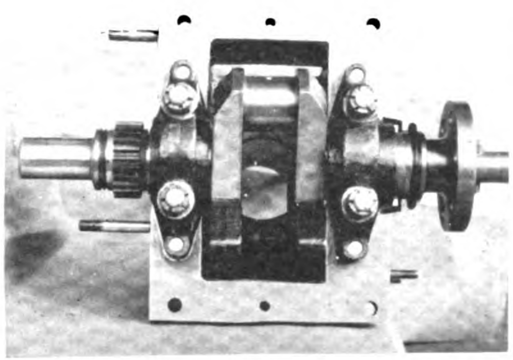
there are no high-pressure oil lines or unions on the outside of the Cummins engine. After the fuel arrives above the injection nozzle, it cools the nozzle so as to prevent formation of carbon on the part of the nozzle which projects into the cylinder, and at the same time raises the temperature of the fuel oil itself. When the intake valve is opened, another charge of fuel oil is injected by means of a small plunger pump under low pressure to the quantity of oil which is already in the injector, and the portion of oil which is to be burned on the next power stroke raises underneath a plunger which has been previously withdrawn. This quantity of oil is completely vaporized by the heat of compression on the compression stroke. At the point at which it is desired to have combustion take place, the plunger drives this highly vaporized fuel, which has been fully prepared for instant burning, into



Notice the sturdy construction

the cylinder, and coming in contact with the hot air of compression burns immediately and completely.

Another interesting feature of the Cummins engine is a small cup cast into the head of the piston into which is screwed a plug having a 1/8 in. hole in the center. For want of a better name this has been called a "sneezer," and functions as follows: As the piston raises on the compression stroke, the pressure in this cup is at all times equal to the pressure in the cylinder, so



Crank and crank case

that at the top of the compression stroke the air in it is at 500 lb. When combustion takes place, the pressure is momentarily higher in the cylinder than in this cup, as there is no combustion in the cup itself. As the piston moves down on the power stroke, the pressure in the cylinder decreases below that of the air in the cup, at which point this captured air rushes out against the tip of the nozzle, blowing away any particle of fuel which may be adhering to the nozzle and assisting in the turbulence of the combustion. This device has no moving parts and contributes greatly to the smooth performance of the engine.

The entire injection principle may be compared to the cracking process of a refinery, excepting, of course, that it is carried to a degree that is very much higher than is possible with the equipment of the refinery, so that when the vaporized oil is injected into the cylinder it is practically a dry gas.

Experiment at the factory has shown that from almost every standpoint the performance of these engines is more than comparable to a similar type of gasoline engine; in fact, the throttling conditions are much better, there is a marked absence of carbon formation, the life of the lubricating oil is practically twice as long, and the wear and tear is greatly reduced.

For starting an engine working on the Cummins principle requires no application of heat in any form for starting, nor is it subject to weather temperatures.

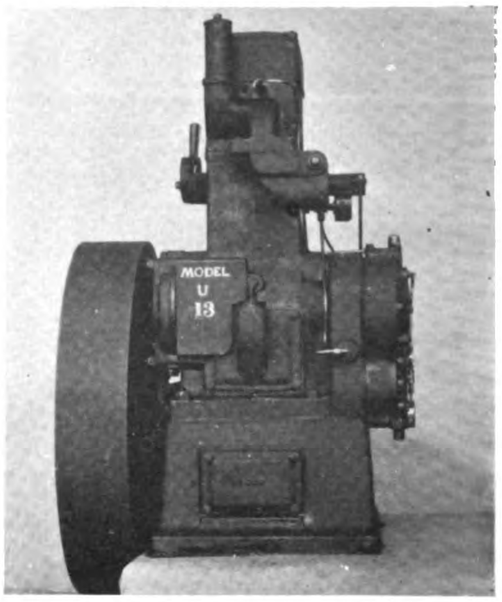
In the matter of design, these engines have been refined to the maximum degree of simplicity, accessibiity (although fully inclosed) and are positively hermetically sealed to prevent oil, smoke or noise coming from the engine.

There is not a place to oil manually nor a moving part exposed excepting the flywheel. The engine is force-feed lubricated even as far as the rocker-arms, and requires practically no attention while running. The controls have been so concentrated that the engine may be operated and started from the bridge-deck, with fewer levers than used on a gasoline motorboat.

A study of the design will show that these engines may be used for generating-sets on Diesel yachts and also have a wide industrial application.

When Commodore C. De Forrest Cummings, of the Buffalo Yacht Club, leads his squadron in the first spring sail, he will have the distinction of being master of probably the smallest Diesel yacht in the world, his new boat being only 39 feet long and having a 6-cylinder, 4½ x 6″ Cummins Diesel engine for power.

When Mr. Paul Hammond and Mr. Elihu Root, Jr., cross the starting-line in the King of Spain transatlantic Cup Race in the 58-foot open racing yacht NINA also



The complete Cummins engine

powered with the new model "U" 4-cylinder Cummins engine, their yacht will take its place among the finest and most costly Diesel-equipped sailing craft on the seas.

These two cases are typical of the trend in motive power for the small yachts of the future, and it can well be said that another branch of Diesel history is in the making. It is possible, in fact, to vision the opening up of a very busy and important industry on these lines.

Rumors of a Repeat Aorangi

A new 20,000 ton motorship will shortly be ordered by the Canadian Australasian Royal Mail Line, according to information given out by J. C. Irons, manager of the company in Canada. Interviewed at his Vancouver office, Mr. Irons stated that officially no announcement had been made by the principals of the firm in Australia, but he knew that a 20 knot motor liner was under consideration for some time past. The new vessel will in all probability be added to the Vancouver-Australia route, but whether it will be an extra ship to augment the service given by the R. M. Ms. AORANGI and R. M. S. NIAGARA, or whether it will entirely replace the NIAGARA has not yet been announced. Mr. Irons believes that by the time the vessel is completed in the fall of 1929 the augmented service will be warranted by increased traffic on the route.

The motorship AORANGI at present sailing from Vancouver was the first large motor liner in the world.

Louis Geraci Converted to Diesel Drive

A 720 hp. 6 cylinder Fairbanks-Morse Diesel has been installed in the LOUIS GERACI owned by N. Geraci & Co., of Tampa, Florida. The LOUIS GERACI was formerly operated as a sailing vessel with auxiliary Diesel power. She has an o.a. length of 166½ ft., a beam of 29 ft., a draft of 10 ft. aft, a dw. tonnage of 750 tons and a net tonnage of 371 tons. She will now be operated as a banana freighter.

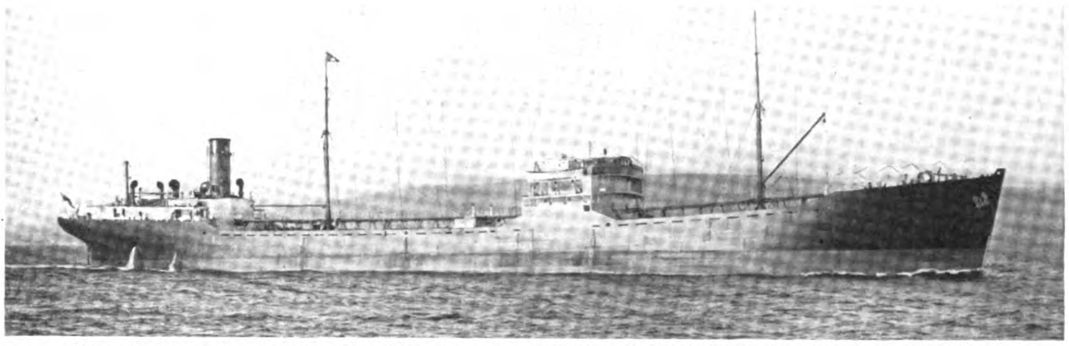
The trend of modern fishing vessels towards Diesel propulsion is shown in the Pacific Coast fishing fleet. Recently 8 new fishing ships, ranging from 38 ft. to 150 ft. in length o.a., have been built and are equipped with Fairbanks-Morse Diesel engines, ranging from a single 30 hp. to twin 120 hp., for propulsion.

The Reading Company of Philadelphia is now completing details for a new Diesel tugboat within the next three or four weeks.

Big Motortanker's Maiden Voyage

Ms. Chesapeake, Owned by Anglo-American Oil Co., Makes First Trip to New York in Weather of Exceptional Severity

THE new motortanker CHESAPEAKE, built by Workman, Clark & Co., Ltd., of Belfast, for the Anglo-American Oil Co., was put in service on January 19 and arrived at New York February 7 after a gruelling maiden voyage. Due to severe North Atlantic weather and with a propeller slip of 36 per cent, she averaged 6.9 knots at an engine speed of 72.1 r.p.m. and with a average fuel consumption of 11.8 tons per day for all purposes. Her engineers are well pleased with her performance, and although her speed of 6.9 knots superficially seems slow, this is not so when we remember that she encountered weather conditions that delayed huge liners for days. It is also interesting to know that she made better time in the crossing than a steam driven tanker in the same service.



The 12,500 ton motortanker Chesapeake, outward bound from Belfast to New York

The CHESAPEAKE is of the two deck type, with poop, bridge and forecastle, built on the Isherwood system of longitudinal framing, and has a "soft nose" or raking stem similar in appearance to that used in the Holt fleet—probably the first tanker to employ this feature of construction. She is 470 ft. in length b.p., 63 ft. 6 in. in breadth, 34 ft. 9 in. in depth, and has a dw. capacity of 12,500 tons. The vessel is divided longitudinally and transversely into 22 main tanks and 10 summer tanks, and oil cargo is discharged by means of two duplex steam-driven pumps, each having a capacity of 300 tons of heavy oil per hour.

She is propelled by an 8-cylinder, single-acting Workman, Clark-Sulzer Diesel engine, the first to be built in Ireland, which develops 2915 b.hp. at 82.5 r.p.m., normal speed, and which provides a sea speed of 10.5 knots in the North Atlantic trade. The maximum speed of the engine is 91.8 r.p.m. developing 3575 b.hp. or 4617 i.hp. with an m.i.p. of 93.7 lb. A noticeable feature of the engine is the massive bedplate which is fastened directly to the engine-room tank top instead of fore and aft girders. Two air injection compressors and a tandem type scavenge pump are driven off the crank shaft of the main engine. Each compressor is capable of supplying main engine injection air at 75 per cent output. Oil fuel is pumped from the cross bunkers to a settling tank from which it runs by gravity through De Laval purifiers into two main engine supply tanks which are used alternately. The ship has a fuel capacity of 760 tons providing a cruising radius of about 12,600 miles.

Auxiliary circulating pumps, forced feed lubricating pumps, as well as fire and bilge pumps are electrically driven, current being supplied by two 4-cylinder 68 hp. Gardner surface ignition engines and a Workman, Clark steam engine each connected to a 40 kw. generator. Ballast, general service, and feed pumps, auxiliary compressors and winches are steam driven with steam supplied by two oil-fired Donkey boilers. One of these is an ordinary 3-furnace Scotch boiler; the other is similar except that the center furnace has been displaced by a nest of tubes through which the exhaust from the main engine can be passed, if necessary, to supply sufficient steam for standby purposes and galley use. Compressed air is stored into 8 high-pressure storage bottles at 1000 lb. pressure and two maneuvering tanks at 400 lb. pressure. An electric-hydraulic steering gear is operated from the bridge by a telemotor. Provision stores, are electrically refrigerated.

Comfortable and roomy accommodations are provided for the crew, which consists, all told, of 38 men. Officers are berthed amidships, engineers aft and the crew forward. Officers' and engineers' quarters are tastefully furnished in mahogany, and a mahogany panelled smoke room is situated at the break of the poop.

Ms. CHESAPEAKE sailed from New York on February 10 with a cargo of refined oil and gasoline for Avonmouth.

Recent Motorshipping News

Crown City's Fine Passage

The recently converted U. S. Shipping Board motorship CROWN CITY, operated by the Roosevelt Lines, arrived in Boston on February 4 with 8700 bales of wool from Geelong, Australia, 4500 tons of iron ore from Whyalla, and several passengers. Her officers report a very fine voyage, and an average speed of better than 11 knots. Ms. CROWN CITY received slight damage in a collision with the British steamer ST. ALBANS at Sydney, but the Admiralty court absolved officers of the American vessel of any blame for the accident.

New Pacific Service

The Dutch Ms. BINTANG, which was converted from steam to Diesel drive in 1923, is giving very satisfactory service according to a report from the Java Pacific Line, her operators. She is engaged in the Far East service from the Pacific Coast and is scheduled to maintain an average sea speed of 12 knots. She left Los Angeles on January 7 bound for Hong Kong, Singapore and Batavia, and is to arrive back in San Francisco on April 12. She is a very successful converted steamer.

Winton-Engined Motoryacht

A new motoryacht is now building at the yards of Pusey and Jones Co., for Samuel A. Salvage. The new ship is 150 ft. long with a 26 ft. beam and a depth of 11 ft. 6 in. She is powered with a pair of 6 cylinder 600 b.hp. Winton Diesels having a bore of 14 in. and a stroke of 16 in. Auxiliary equipment consists of two 10 kw. generators, a fire and bilge pump set, a fuel oil transfer pump and a motor driven air compressor—all of which are of Winton manufacture.

Bids Opened for 13,000 Ton Tanker

The Standard Oil Company of California has opened bids for a new Diesel-electric tanker of 13,000 tons. The bidders and bids were as follows: Newport News Shipbuilding Co., $1,625,000 and 420 days; Sun Shipbuilding Company, $1,687,000 and 300 days; Bethlehem Shipbuilding Corp., $1,-739,000 and 499 days; Moore Dry Dock Co., $1,875,000 and 15 months; Los Angeles Shipbuilding Co., $1,896,000 and 390 days; American Brown Boveri, $1,925,000 and 480 days. Four 1,000 hp. Busch-Sulzer Diesel engines, originally ordered for the tanker DISTRICT OF COLUMBIA, will be installed in the new ship, which when complete will be a very up to date unit. At the time of going to press no award has been made.

It is understood that the Lloyd Triestino is planning the reorganization of its services in the Near East and Levant. Three motorships, the ASSIRIA, CALDEA and PALESTINA, are to be placed in service.

The Principles of Supercharging*

Details of Its Advantages, Its Field of Application, Its Limitations Together with a Notation of Recent Experimental Work

By Eng. Comm. C. J. Hawkes, R. N.

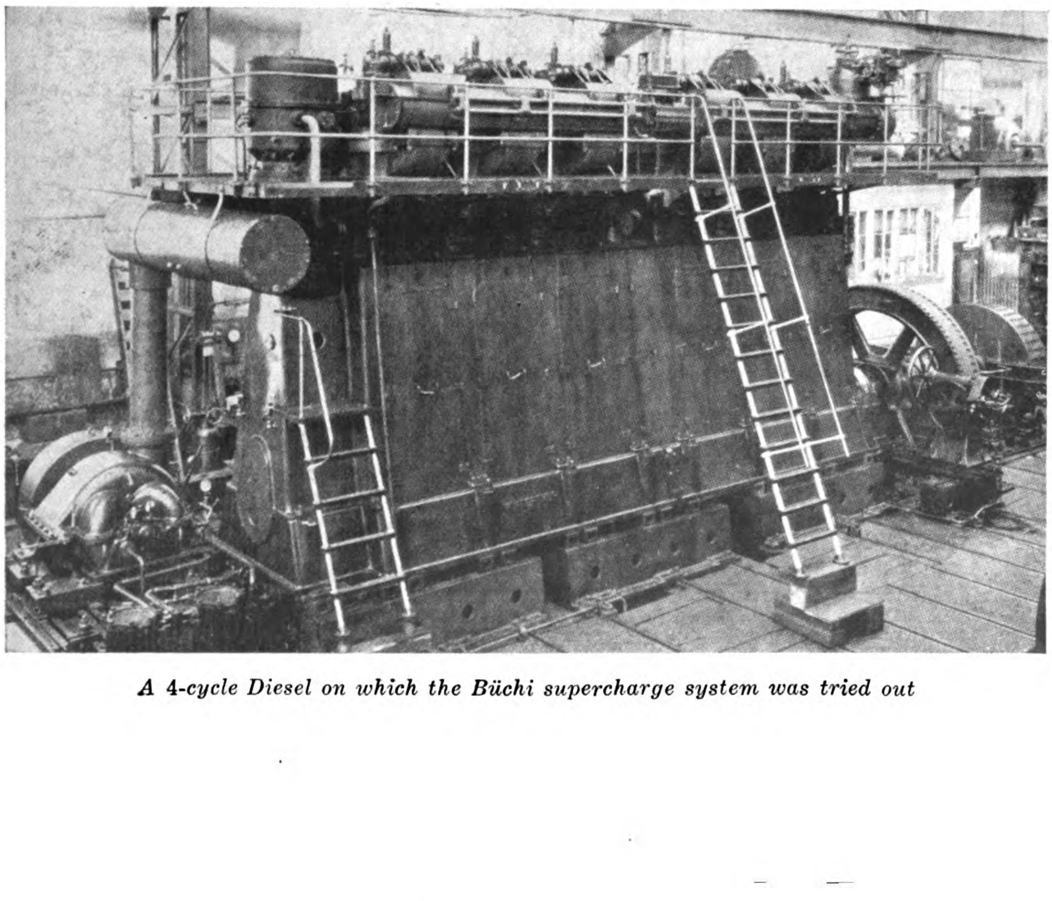
SUPERCHARGING is not a new idea; it was originally proposed by Daimler. Supercharging experiments were carried out by Junkers with his opposed-piston oil-engine, and he referred to the advantages of supercharging in a Paper[1] which he read in November, 1911. But, with the exception of some experimental installations, very little has been done with supercharging until recently, and there are now a number of marine four-stroke engines fitted with superchargers.

Sir Dugald Clerk, dealing with the temperature difficulties in large gas-engines, has called attention[2] to the advantages arising from the adoption of supercompression, i.e. the introduction of additional air or cooled exhaust gases after the ordinary inlet valve has closed, thus increasing the charge weight per cycle, and maintaining or increasing the mean pressure whilst materially reducing the maximum and mean temperatures. These remarks are applicable to the oil-engine. On account of the additional cost, however, I do not think that supercharging is justified if adopted for the sole purpose of reducing cycle temperatures; but if higher mean pressures can be employed than those favored or permissible at the present time, without increasing the safe working-cycle temperatures, then there is some justification for supercharging.

The introduction of supercharging air into an engine would, if no changes were made, result in an increase in the maximum pressure. If it were desired, therefore, when supercharging, not to exceed the maximum pressure reached without supercharging, it would be necessary to inject the fuel slightly later, and this would tend to increase the fuel consumption. Assuming that air-coolers were not fitted, the temperature of the supercharging air delivered by the pump would also be slightly higher than that of the air supplied to the non-supercharged engine, and this, together with a possible slight increase in fuel consumption and reduced heat loss to the jackets per unit weight of working fluid, would result in slightly higher cycle temperatures if the mean pressure were increased in proportion to the increase in the weight of air supplied to the engine. In practice, however, the increase in mean pressure, over that employed in the non-supercharged engine, would be less than the increase in the weight of air supplied, so as to ensure that the cycle temperatures, and the accompanying heat stresses in the cooled parts, would not be greater than in the non-supercharged engine or exceed safe working limits. Advantage might be taken of the slightly higher temperature of the supercharging air supplied to the engine by reducing slightly the compression ratio employed, but in doing this one must not overlook the possibility of the engine being required to start readily, and also work at low powers, without supercharging.

When considering the question of supercharging some years ago, with the object of employing higher mean pressures without increasing cycle temperatures, I came to the conclusion that for 4-stroke engines which would not be required to develop their full rated power continuously, it would be preferable to arrange for the air to be drawn in through the inlet valve in the usual manner and to add the supercharging air towards the end of the suction stroke through ports uncovered by the piston, and a design for modifying an experimental engine on these lines was completed. With this arrangement it is only necessary to provide sufficient pumping capacity for supplying the additional or supercharging air; and the pump or blower can be put out of action when not required. Moreover, this arrangement also has the advantage that the supercharging air can be given a rotary motion in its passage through the ports, which should assist combustion where airless injection is employed; but the introduction of ports in the liner, and the other necessary fittings, certainly leads to complication. The alternative is to fit a pump or blower capable of dealing with the whole of the air supplied to the engine when supercharged, and this has been done in some instances. Some interesting results have been obtained with an experimental installation fitted with the Büchi system of supercharging. The engine tested was a 4-cylinder 4-stroke engine, normally developing 500 b.hp., and the air was supplied by a 2-stage blower driven by an exhaust-gas turbine. The blower was not specially designed for the purpose and an electric motor was therefore employed to assist the gas-turbine to supply the amount of supercharging air which it was estimated would be delivered by a gas-turbine driven blower correctly designed for the installation. The supercharging air was passed through coolers, the compression ratio of the engine was slightly reduced, and the maximum cycle pressure was limited to that reached in the engine when running non-supercharged. The openings of the inlet and exhaust valves were arranged to overlap so that at the end of the exhaust strokes the compression spaces were scavenged. The power developed with supercharging was limited to that which gave the same exhaust-gas temperature reading as that recorded at the rated power without supercharging. It was found that with a supercharging pressure of 0.5 atmosphere the power of the engine was increased by about 50 per cent, i.e. to 750 b.hp.; the fuel consumption per b.hp.-hr. was about the same, and the heat loss to the jackets was slightly less, than when the engine was running without supercharging and developing 500 b.hp. These results show that even though the power was increased by 50 per cent with supercharging the heat stresses were about the same as when the engine was running

(Continued on page 229)



A 4-cycle Diesel on which the Büchi supercharge system was tried out

* Abstracted from the Thomas Lowe Gray Lecture read before the Institution of Mechanical Engineers, London, on January 6.

[1] Jahrbuch der Schiffbautechnische Gesellschaft, 1912, page 264.

[2] "The Gas, Petrol and Oil Engine," Vol. II, Clerk and Burls, 1913.

Economy of a Diesel-Electric Dredge

Costs for Two Types Operated by The Port of Portland Shows Diesel Craft Produces One-Third More Power at Half the Cost

By James H. Polhemus*

THE Port of Portland Commission, which is an instrumentality of the State of Oregon and is responsible for improvement of the Willamette river, below Portland, Oregon, and Portland harbor for navigation, has one of the largest fleets of dredges in the United States. It has maintained a dredging organization for 30 years, and its plant has grown from one small hydraulic dredge in 1898, representing an investment of about $70,000, to a fleet of four large dredges with auxiliary plant representing a value of $2,087,103 at this time.

It is unusual for a community to do what has been done through The Port of Portland Commission. Most ports throughout the country have depended upon the Federal Government to provide them with channels or to improve and make adequate such natural channels and harbor as existed. Portland was a natural harbor at the head of deep sea navigation, 110 miles from the sea via the Columbia and Willamette rivers. It was to its harbor the sailing vessels came soon after the first permanent settlers in the Oregon country had established themselves in the fertile Willamette valley. As the tributary country developed the Port of Portland of necessity developed with it. Greater depth of channel and a larger harbor were required.

More than 30 years ago Portland decided it could not wait upon such uncertain aid as might be forthcoming from the Federal Government so far as its local harbor was concerned and took on the job itself. However, the Government did later improve the Columbia river and particularly the entrance from the sea which is now adequate in depth and width to accommodate the largest vessels.

The Port of Portland's problem was mostly one of dredging and it has developed the local harbor as the needs of its commerce required. It is now well advanced upon a project for a uniform minimum depth of 35 ft. throughout the harbor.

The dredging work has different requirements now than those of a few years ago. Nearby disposal areas have been filled with material removed from the river and this has necessitated the use of longer pipe lines to reach more distant lowlands which fact, in turn, has called for higher powered dredges.

In 1925 The Port of Portland constructed its high powered Diesel-dredge CLACKAMAS, which is a 30-in. hydraulic pipe line dredge, as are all its present dredges. The CLACKAMAS differs from the others not only in being higher powered, but also in that it is powered with Diesel engines as prime movers. These drive d. c. generators and all dredging machinery: i. e., dredging pump, cutter, winch, etc., are electrically driven. All the other dredges are steam powered with various layouts.

The harbor, Portland, Ore., in which the Clackamas has so successfully functioned

This dredge was the first large hydraulic pipe line dredge to make use of the Diesel-electric combination and, as it has been in operation over a much longer period than any other of its type it is thought that an exhibit of operating results and particularly operating and maintenance costs will be of interest.

At this time we are able to set forth not only the experience of over two years of operation but also the cost of maintenance of the vessel and her plant over that period.

The cost of maintenance for this type of plant has heretofore been an undetermined factor and obviously will be to some extent until a longer experience is gone through. We believe, however, that, as the CLACKAMAS has handled over 12,000,000 cu. yds. of material, mostly sand and gravel, and has recently undergone a thorough overhauling of the wearing parts and of those elements subject to severe stresses, the figures herein given should be of some value.

To add to their value to those interested in comparing a steam dredge with a Diesel-electric dredge, we have set up the operating and maintenance costs of our steam dredge TUALATIN alongside of those for the CLACKAMAS. The performance of both in yardage and length of line handled is also shown in parallel columns.

These dredges are the same size as to suction and discharge pipe, being 30-in. dredges. The TUALATIN operates on 250 lb. steam pressure. The dredge pump is driven by twin 1000 hp. turbines through a 3600 by 300 reduction gear. The cutter is also

Table "A"

Performance Data

COMPARISON OF OPERATING AND MAINTENANCE COSTS BETWEEN THE PORT OF PORTLAND'S 30-INCH HYDRAULIC PIPE LINE DREDGES TUALATIN AND CLACKAMAS OVER A LONG PERIOD OF OPERATION

	DREDGE TUALATIN	DREDGE CLACKAMAS
Type of Dredge	30 in. Hyd. Pipe Line	30 in. Hyd. Pipe Line
Type of Power Plant	Steam geared turbine	Diesel Electric
Shaft Hp. Drg. Pump	2000 S.hp.	2700 S. hp.
Period Compared	Fiscal yrs. 1925-26-27	Same, commencing August, 1925
Number of Oper. Days	810	623
Cubic yards dredged	8,895,990	12,286,025
Avg. cu. yds. per operating day	10,980	19,720
Avg. length pipe line	3,224 ft.	5,126 ft.
Avg. lift of discharge	25 ft.	25 ft.
Max. length of pipe line without booster	6,900 ft.	10,650 ft.

Recapitulation of Cost and Performance Data

Cost per Shaft Hp. Year**

	DREDGE TUALATIN	DREDGE CLACKAMAS
Operation:		
Hog fuel basis	$56.39	......
Oil fuel basis	(88.99)	$50.92
Maintenance	24.14	24.64
Total. Hog fuel basis	$80.53	$75.56
Total. Oil fuel basis	(113.13)	
Cost per cu. yd. Operation and Maintenance (including Booster Cost* when used):		
Hog fuel basis	0.0489	......
Oil fuel basis	(0.0746)	0.0345

*An electric booster of 1,800 S.hp. used during 180 operating days of total of 810 operating days of dredge TUALATIN.

**As total operating time of dredges varied a year of 300 operating days is used to make this comparison.

*General Manager and Chief Engineer, The Port of Portland, Portland, Ore., contributes exclusively to MOTORSHIP.

turbine driven. (Kerr turbines, now built by the Elliott Co., are used.)

The CLACKAMAS has four McIntosh & Seymour Diesel engines totalling 3400 b.hp., with the four engine generators delivering 2300 kw. of electric energy at the main buss. The normal demand of the dredge pump is 2700 hp.

Table A gives, in briefest form, a summary of performance of these two dredges together with a recapitulation of cost and performance data and is self-explanatory. We have used two units for boiled down comparisons; viz. "horse-power year" and "cubic yard."

We believe the horsepower year unit the best for comparing costs of the two dredges as mechanical units. This is particularly true of maintenance.

The comparison on a cubic yard cost is valuable only if dredges have been very similarly situated as to nature of material, outside interference, etc. In this case the conditions under which both dredges worked were similar. The CLACKAMAS was used in the heaviest banks of sand, which would naturally give greater yardage, but to offset this it handled a much longer pipe line. In other words, being the most powerful and therefore capable of pumping against a greater head, this dredge was assigned to the heavier pumping long pipe line jobs.

Much of the TUALATIN'S work was in the same locality and material and some of it in extremely heavy gravel. Under some conditions it was necessary to place a booster pump in the TUALATIN'S line.

In arriving at the cost per yard the booster costs are included. We think that with this explanation the comparisons are fair.

The net result of the comparison is that maintenance costs are practically the same for both on a pump shaft horsepower basis; that operating costs on that basis are less for the Diesel-electric than for the steam turbine dredge.

It is in the cost per cubic yard of output that the Diesel-electric dredge makes the greatest showing for economy.

It will be noted that the CLACKAMAS shows the lower cost per yard even against the TUALATIN with the latter on a "hog fuel" basis. With the TUALATIN on an "oil fuel" basis the CLACKAMAS shows a cost per yard of less than half of the TUALATIN. Fuel oil in this district costs $1.30 per barrel. As it is much higher priced in many parts of the country the Diesel dredge would show to even better advantage in those localities.

In addition to this the CLACKAMAS must be given credit for the extra work performed which does not show in the cost per yard. For instance in the "performance data" in table A it will be noted that the CLACKAMAS not only pumped almost twice the yardage per day (19,720 against 10,980 cu. yds.) but delivered through an average of 5126 ft. of pipe line while the TUALATIN'S average pipe line was only 3224 ft. The net terminal lift, or vertical head, was the same for both as filling was done at elevation plus 32 ft. on river gauge and, allowing for variations in river stage, the net average life was 25 ft.

We would not wish these observations to create the impression that the steam turbine dredge is inefficient, for the writer knows it to be a reliable and effective type of power for hydraulic dredges, but, when compared to a Diesel or Diesel-electric dredge, with oil as the boiler fuel for the steam dredge, it is apparent, from our experience, that the Diesel-electric has the better of the comparison. We are not taking first cost and depreciation into our figures.

On the other hand, where the extremely cheap hogged wood fuel which is mechanically cut or chopped lumber mill waste, such as we use, is available in steady supply, there would not be so much argument for the Diesel tpye. In our case the motive was principally that of obtaining greater self-contained power. The initial power contained in the CLACKAMAS of 3400 b.hp. could not readily be obtained in a hog fuel-burning dredge for our purposes for many reasons. The most obvious are boiler and furnace space; difficulty of transferring such bulky fuel from supply barge to furnaces in sufficient quantity; cost and upkeep of barges; unreliability of fuel supply at times, encumbrance of plant with supply barges. There are many other objections which would apply and each of those named as well as others that might be recited are subject to dispute, depending upon operating conditions, also investment required.

In rough or swift water, the necessity of having barges continuously alongside might be a fatal objection. It would also prevent operation in narrow places, such as pier slips or small canals.

Having both types of dredges these considerations do not affect us now but they are suggested here as thoughts that are worth considering in cases where a dredge for general utility purposes is planned.

Table "B"

Condensed Cost Data

COMPARISON OF OPERATING AND MAINTENANCE COSTS BETWEEN THE PORT OF PORTLAND'S 30-INCH HYDRAULIC PIPE LINE DREDGES TUALATIN AND CLACKAMAS OVER A LONG PERIOD OF OPERATION.

	Dredge Tualatin		Dredge Clackamas	
Operation	Totals for 810 Oper. Days	Avg. for Oper. Day	Totals for 623 Oper. Days	Avg. per Oper. Day
Labor—Oper. only	$147,079.04	$181.58	$116,958.71	$187.73
Fuel—Hogged-wood	56,656.02	69.94	....	......
Fuel—Oil	*(232,745.50)	(287.34)	64,839.45	104.09
Engine Dept. Supplies	5,059.78	6.25	25,478.43	40.90
Deck Dept. Supplies	4,934.94	6.09	5,714.36	9.17
Auxiliary Oper. pro rata	30,754.71	37.97	23.526.09	37.76
Subsistence	33,170.19	40.95	24,286.84	38.98
Marine and Liab. Ins.	26,795.53	33.08	24,710.78	39.66
Totals { Hog fuel basis	$304.450.21	$375.86	....	......
Totals { Oil fuel basis*	480,539.69	593.26	$285,514.66	$458.29
Maintenance				
Cutting Machinery	$9,004.35	$11.11	$5.474.46	$8.79
Suction and Discharge Pipe—30-in. contained	12,418.96	15.33	4,753.75	7.63
Swinging—Spudding gear	6,398.55	7.90	9,777.90	15.69
Dredging Pump	28,364.62	35.02	47,083.72	75.58
Power Plant and Aux	38,963.35	48.10	44,880.76	72.04
Hull and Superstructure	8,819.97	10.89	8,032.67	12.89
Miscellaneous Plant	15.138.06	18.69	9,595.20	15.40
Supplies and Sundries	8,414.18	10.38	7,226.67	11.60
Marine and Liab. Ins.	2,868.25	3.54	1,327.72	2.13
Totals. Maintenance	$130,390.29	$160.96	$138,152.85	$221.75
Grand t tals { Hog fuel basis	$434,840.50	$536.84	....	......
Grand t tals { Oil fuel basis	*610,929.98	754.23	$423,667.51	$680.04
Booster Operation				
Oper. cost for electric booster when used	$52,848.87	......	....	......

*Hogged-wood fuel was used on Dredge TUALATIN, but as this cheap fuel is peculiar to certain few localities, the fuel cost is here transposed to an oil fuel basis, and thus makes the comparison stand as between an oil fired, steam and a Diesel electric dredge. The cost of fuel oil was $1.30 per bbl. of 42 gals.

As heretofore indicated oil fuel must be considered for a steam plant for marine work in most localities, and it is the comparison between the oil-fired steam dredge and the Diesel-electric dredge that should have the widest interest. It is for that reason we transposed our costs to an oil basis.

To show how the total costs are distributed as to different units or groups of units contained in a dredge, we have prepared a table of condensed cost data which is given as table B. This table also makes a definite division between "operation" and "maintenance."

As the operating period was not of the same length for both dredges the average per operating day is also shown for each group and these daily averages are the figures that should be compared rather than the group totals.

A little further analysis of table B may be interesting. Taking the "Operation" division alone, we can observe that in the "per day" column the items of "Labor," "Deck Department Supplies," "Auxiliary Operations" (tenders, etc.), "Subsistence" and "Insurance" are practically the same for both dredges. They may, therefore, be cancelled. We have left them only "Fuel" (oil fuel only to be considered) and "Engine Department Supplies." If we combine these two for dredges we show:

TUALATIN. Fuel and Engine Dept. Supplies	$293.59 per day
CLACKAMAS Fuel and Engine Dept. Supplies	144.99 per day
Difference	$148.60 per day

This tells the whole story of operating economy and probably would not be much different, relatively, if the engine room were furnishing power for any other purpose than driving dredging machinery. It shows that the Diesel, although generating one-third more power, produced that power at about half the operating cost of the oil-fired steam plant. I might say here that the much greater cost per day on the CLACKAMAS in the item of "Engine Department Supplies" is mostly due to the quantity of lubricating and piston cooling oil used. This, as we have seen is easily absorbed in the fuel economy and the net result is as indicated above, a clear saving of one-half in favor of the Diesel plant.

Refer now to the "Maintenance" division of table B. Here we may cancel, in the average per day column, "Cutting Machinery" "Hull and Superstructure," "Miscellaneous Plant," "Supplies and Sundry," as about equal for both dredges. This leaves—"Suction and Discharge Pipe" (contained in dredge), "Swinging and Spudding Gear," "Dredging Pump" and "Power Plant," as the items where large differences appear. We can conscientiously disregard the first three as they are units of much the same type in both dredges and maintenance means only making up for wear caused by abrasive material in the pipe and pump and breakage of spuds. This leaves only the power plant and its auxiliaries to compare. In this case the comparison is against the CLACKAMAS on the face of the daily average figures, thus:

CLACKAMAS—Maintenance of Power Plant and its Auxiliaries	$72.04 per day
TUALATIN—Maintenance of Power Plant and its Auxiliaries	48.10 per day
Difference	$23.94 per day

These power plants are not of the same capacity so we, to be fair must use the power factor. Let us combine the "Operating" and "Maintenance Costs" for the "Power Plants" only on a pump shaft horsepower basis thus:

	TUALATIN	CLACKAMAS
Usable S.hp. at pump....	2000 Steam	2700 Electric
Cost for Power Plant only:		
*Operation per day	$293.59 Oil fuel	$144.99
Maintenance per day	48.10	72.04
Total per day	$341.69	$217.03
Operation per S.hp. year**	$44.04	$16.11
Maintenance per S.hp. year	7.21	8.00
Total	$51.25	$24.11

**Based on 300 operating days per year.
*Labor for operation paired out for both dredges.

This net result is self-explanatory. While we do not contend that these costs should hold true on any plant other than a dredge, obviously they cannot be very far from right as to relationship of costs for the one type of plant as against the other working under similar conditions.

Oil is the largest item shown in the contained data of operating costs for the dredge CLACKAMAS, with the exception of labor. The latter requires no special analysis as it is not peculiar to this type of dredge, but as to oil used some details may be of interest.

For lubrication of Diesel engines, we have tried several kinds of lubricating oils. It was found that the asphaltic base lubricating oils made from Western crude petroleum were more satisfactory than those derived from paraffin base petroleum. The disadvantage of the latter though slight, is principally that a harder carbon is formed by them and the Eastern oils cost considerably more on the Pacific Coast.

During December, 1927, for 557 running hours of the Diesel engines, 364 gal. of Heavy Calol Diesel Engine Oil were used for cylinder lubrication, costing 50½c per gal. For bearing lubrication and piston cooling, 869 gal. of Light Calol Diesel Engine Oil, costing 35½c per gal. were used. Of these 869 gal. probably 500 gal. were consumed in the piston cooling system. This piston cooling system applies only to the two 900 b.hp. engines, as the 800 b.hp. engines do not have oil-cooled pistons.

Operating with an engine load factor of 90 per cent the power plant of the CLACKAMAS generates on an average about 3000 kw. hr. of the electrical energy or 4430 b.hp. hr. per gal. of cylinder oil. For the bearing and piston cooling oil used, the average output is about 1224 b.hp. hr. per gal.

During the first year of operation, the CLACKAMAS engines were run with ordinary commercial fuel oil, the same oil as is burned under steam boilers and which costs $1.30 per bbl. of 42 gal. The average gravity tests of this oil is 16 deg. Beaumé. During the past year and at present, however, the oil used is what is known as "commercial Diesel oil" which runs from 24 deg. to 28 deg. Beaumé gravity and costs about 20c more per bbl.. of 42 gal. than the 16 deg. fuel oil. This reflects an additional cost of about $440 per month on the 2200 bbl. average fuel consumption.

As to the quantity: We found that practically the same number of barrels are required to generate a full month's electrical load of 1,100,000 kw. hr. whether common fuel oil or commercial Diesel Oil is used. The engines run perfectly on boiler fuel oil and no extra maintenance was traceable to its use as against the regular Diesel oil. The cylinder liner wear was practically the same: viz. about 1-1/1000ths in. per month with either fuel.

On this dredge it has been found important and necessary to run the Diesel oil as well as common fuel oil through the centrifuges and approximately the same quantity of foreign matter is taken from a given quantity of either grade of oil.

The reason we changed from using common fuel oil to the lighter Diesel oil after the first year's operation, was that the latter is much easier to handle, especially in cold weather. The common fuel oil must be heated so that it will flow readily in the pipes and was not as stable for starting the engines. Every time it was necessary to shut down the plant, and this happens frequently in the case of a dredge, it was necessary to keep the engines running about 15 minutes after the "stop" signal had been given in order to use up the fuel oil in the pipe leading from the heated "day tanks," the valves being at the same time set so that by the time the engines were stopped the lighter Diesel oil would be in the pipes for the next starting. In other words, the engines had to run 15 minutes in order to consume the heavier oil and allow the feed line to fill with the lighter oil. After the engines were again started with the lighter oil, it was a simple matter to reset the valves to continue the run on the heavy oil, but there was always the extra consumption in making the change when shutdowns were required. This accounted for the reason that about the same result was obtained with a barrel of Diesel oil, even though it contained less heat value than the heavier boiler fuel oil.

This idling for the purpose of changing the oil in the piping system proved detrimental in many ways to the operation of the Diesel engines, which operated at their best when run on full loads. If this power plant were on shore or situated where there was plenty of room to provide adequate facilities to handle the heavier fuel oil and the load was constant, thus eliminating the shutdowns off and on during the day, it would no doubt be advantageous to use the heavier boiler fuel oil and again the saving represented by the lower price on that grade. As heretofore demonstrated through our experience, air injection Diesel engines, such as we have, can be expected to give entire satisfaction operating on the cheaper fuel and whether or not this is used to advantage, depends upon the operating conditions. Even the disadvantage of changing the oil for starting and time consumed in idling are mentioned as reasons for changing to the light oil, but it is obvious that such change was made because a choice was possible and in the case of this dredge there was an operating condition which gave a preference to the lighter oil. It is clear, however, that these engines can be very successfully operated with the use of common boiler fuel oil should other conditions arise which would offset the favorable advantage we have set as existing for the Diesel oil. For instance, if the difference in price should become a greater consideration or scarcity of the lighter Diesel oil preclude its use, we would have no hesitancy in using the common fuel oil.

The air compressors on the Diesel engines have given little if any trouble. Their splendid performance has been an agreeable surprise to all of us.

In this review we have set forth not only the fact that this large installation of Diesel engines has been successfully operated over a period of two years running day and night for 6 days a week; that maintenance cost has been reasonable and also that as a prime mover for an electrically driven high powered dredge, the plant has been a success, therefore the machines and their manufacturers will automatically receive deserved credit and commendation. There is another element, however, to be considered in the successful operation of any machine or plant and that is the personal element. Much credit for the successful and economical operation of the Diesel-electric dredge CLACKAMAS is due to the chief engineer of that plant, Mr. Clyde Teeling, and to the dredge's master mechanic, Mr. James Healy, and if the writer fails to say that it is to the skill and conscientious attention given by these men to this expensive plant, especially when the type was new, not only to this district but to dredging in general, the story of these two successful years would not be completely told.

"Isherwood" Ship Construction System

THE twentieth year of activity for the "Isherwood" System, we are informed marks an epoch in ship construction development inasmuch as this year's return shows remarkable progress in the adoption of The "Bracketless-System." At the end of 1926, there were built and contracted for on the new system, 14 vessels aggregating 180,000 tons deadweight carrying capacity, which at the close of 1927 has increased to 41 vessels representing 412,000 tons deadweight and with the ships placed on the pure "Isherwood" System a total of 67 vessels have been contracted for in the year.

Among a few of the important contracts awarded during 1927, may be noted the 17,000 ton motortanker ordered by the California Petroleum Company from the Sun Shipbuilding and Dry Dock Company, Chester, Pa., and completed this month, three motortankers of 15,000 tons deadweight placed by the Gulf Refining Company with the Furness Shipbuilding Co., Ltd., of Haverton Hill, one motor tanker of 16,000 tons deadweight by Imperial Oil Limited of Toronto with the same builders, one motortanker of 15,000 tons deadweight by the Standard Oil Company of California with Messrs. Fried Krupp Germaniawerft of Kiel-Gaarden, Germany, and six more of a special type by The Gulf Refining Company with Palmers Shipbuilding & Iron Co., Ltd. The latter are for service in transporting oil from Maracaibo to the Caribbean Sea to be discharged into ocean-going ships.

The Scandinavian countries have shown increased activity in shipbuilding during 1927, and from being amongst the first to consider the "Bracketless-System" have developed their interest to the extent of building several large oil tankers. Important contracts this year include three with an aggregate deadweight capacity of 35,000 tons by Burmeister & Wain of Copenhagen, two representing 25,000 tons by Kockum Mek. Verksted of Malmo, and a further tanker of 11,350 tons by Odense Staalskibsverft for Mr. A. P. Moller of Copenhagen. All these ships are motorships. Two other interesting vessels are one of 10,000 and another of 17,500 tons contracted for by Cantiere Navale Triestino of Monfalcone, the remainder being shared between Great Britain and America. Builders and owners in the latter country particularly have maintained their favorable attitude towards the "Isherwood" System by adopting it, not only for oil tankers, but for other types including first-class passenger and cargo carriers.

Many ships have been launched during the course of the year, and foremost amongst these is the C. O. STILLMAN—the largest Oil Tanker in the world—built on The "Bracketless-System" to the order of Imperial Oil Limited of Toronto. The second largest, the GULFPRIDE, was built in America for the Gulf Refining Company by the Federal Shipbuilding and Dry Dock Company at Kearny, N. J.

Design Refinements from Higher Speeds

Airless Injection Engine of New Type Now Being Produced in Sizes Ranging from 50 Hp. to 1500 Hp.

WE have previously called attention to the great interest taken in small high speed Diesels at the New York Motorboat Show. An engine of this type which attracted great attention was a 6-cylinder 4-cycle unit, with 8-inch bore, 10-inch stroke, developing 200 hp. at 700 r.p.m., was displayed at the recent New York Motor Show. It certainly offers, in its smaller sizes, a very attractive proposition for yacht owners and owners of work boats.

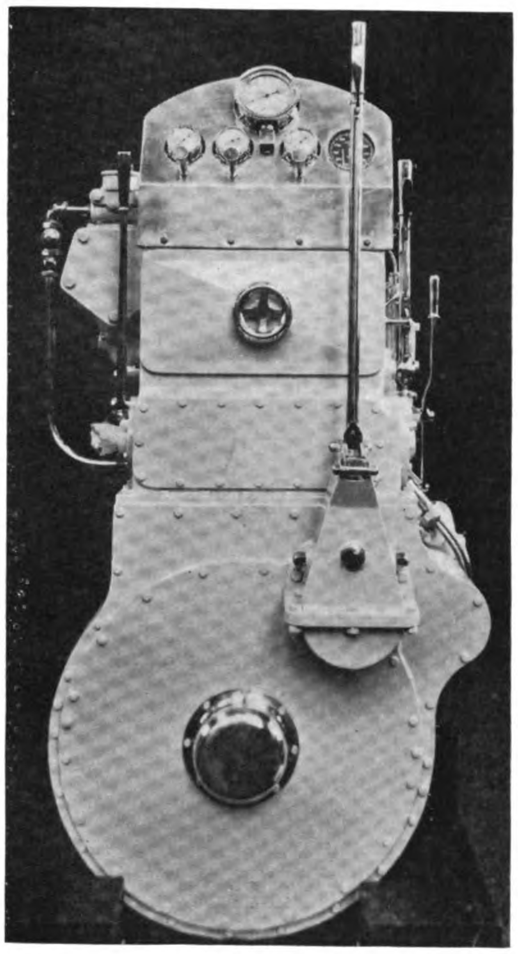
This new type is a 4-cycle Winton engine with refinements over the conventional type of marine engine. It produces high power for a given cylinder displacement, and the various units are compact, with combination of light weight and rugged strength. They are characterized also by minimum number of parts, precise balance, low operating cost, and superlatively quiet, smooth performance.

All control levers in the engine illustrated herewith, as well as the instrument board with gauges, are conveniently located at the front end. All working parts are readily accessible, and are lubricated by pressure feed. Reversing is accomplished simply by shifting the camshaft by means of a conveniently located hand-lever.

Fuel is fed directly from the main fuel tank through a 3-cylinder plunger-type pump into the fuel manifold and from there is injected under pressure into the cylinders, through a special needle-type injection valve, which is camshaft operated. Fuel is ignited by heat of compression only.

Throttling down is accomplished by reducing pressure on the fuel oil and shortening duration of combustion.

In the 6-cylinder model, the cylinder block is made of close-grained charcoal iron and is a one-piece casting, securely bolted to the top



Control end of the new Winton Diesel

crankcase. Into this casting are inserted six close-grained charcoal iron cylinder liners. The cylinder block is provided with cleaning holes. Removable plates on the push rod side permit ready inspection of valve roller plugs and push rods.

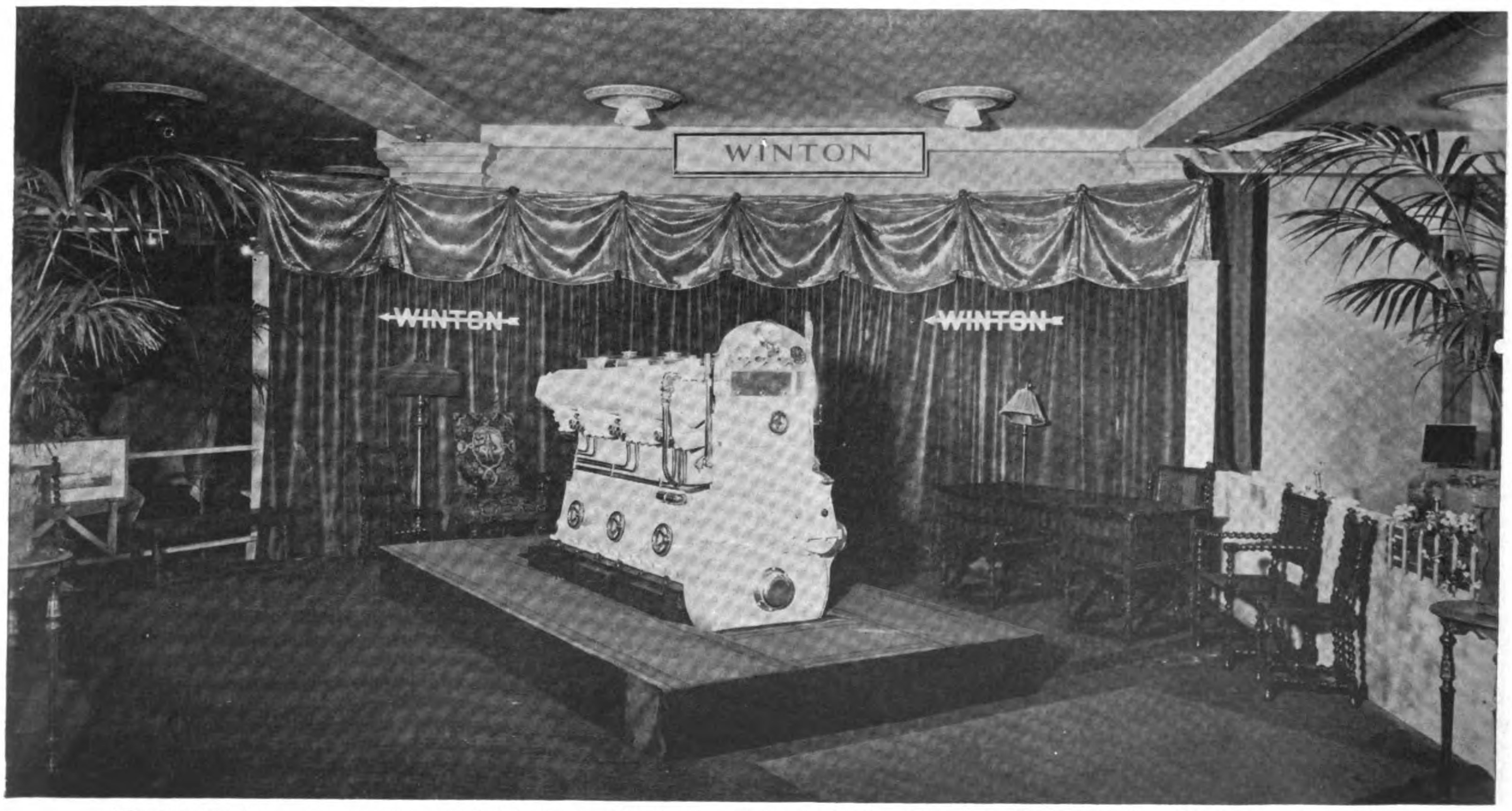
The cylinder liners are close-grained chrome nickel iron cylinder liners, machined and ground to mirror smoothness, insuring simplicity in removing cylinder walls, and thereby reducing upkeep. They are machined on both sides, providing uniform thickness, resulting in maximum and even cooling of liners and pistons. Each liner is sealed at the top by cylinder head and gasket, and tightly packed at the bottom by a rubber ring.

The top crankcase is made of special aluminum alloy in one piece, cast with stiffening ribs to insure rigidity. It carries five babbitt-lined bronze shells for the camshaft. Large handhole plates on both sides afford ready accessibility to main bearings, crank pin bearings, and camshaft bearings. A gear case on the forward end encloses the camshaft gear train.

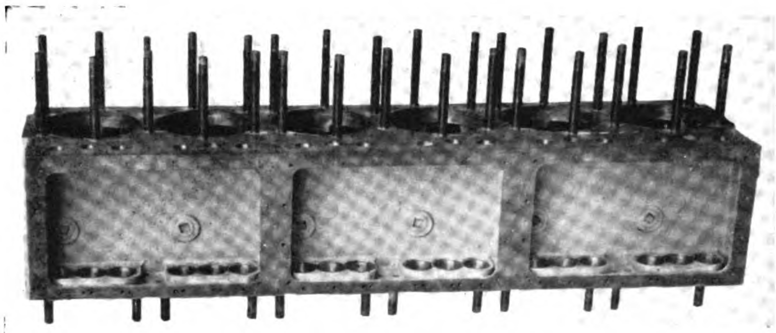
For the bottom crankcase there is a semisteel casting, which carries the crankshaft in seven main bearings, which are cast integral with case. Seatings are accurately machined to receive babbitt-lined removable steel shells, held in place by cast iron caps and fitted bolts. The crankcase is strongly ribbed and held down by a sufficient number of steel bolts.

All cylinder heads are readily detachable, without removing the intake or exhaust manifolds. They are made of the same material as the cylinder block, cast in pairs, thoroughly water jacketed, and secured to the cylinders by high carbon studs. They are fitted with valve stem bushings.

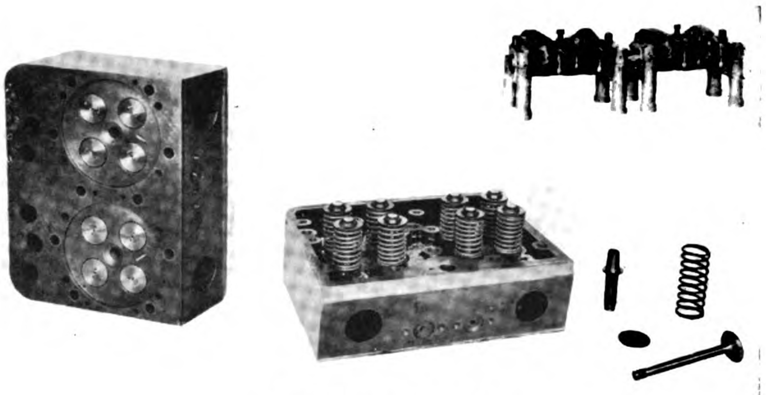
Removable cylinder head covers, made of aluminum, are incorporated in the design.



The Winton Company made a special feature of their new airless injection Diesel at the recent New York Motorboat Show



Cylinder block assembly



Valve gear assembly

They entirely enclose all the valve mechanism, being held in place by polished brass hand wheels. They are oil-tight.

Pistons are made of nickel copper aluminum alloy, ground the full length and fitted with five rings above wrist pin. Wrist pin bearings are carried in the piston and are lubricated by force feed. Wrist pins are made of chrome nickel steel, hollow bored, hardened and ground and clamped securely in connecting rod.

There is a chrome nickel steel crankshaft of high tensile strength, subjected to rigid inspection. The crankshaft is 4½ in. diameter and is seated in seven main bearings. The entire shaft is machined and drilled from the main bearings through cheeks and pins for lubrication. All bearings and pins are ground. The bearings are steel shells, lined with best high-grade government genuine babbitt scraped to fit.

Connecting rods are "I" section drop forgings, chrome molybdenum, electric furnace McQuade EHN tested steel. Lower ends are all fitted with detachable steel shells, lined with best high grade government genuine babbitt scraped to fit.

Intake and exhaust valves are in the cylinder heads, and enclosed by oil-tight covers. They are made from special silchrome alloy steel, to withstand severe usage and intense heat. All valves are especially large and are operated from a single camshaft.

The rocker arms are chrome nickel steel drop forgings, bronze bushed, operating on top of the cylinder heads by push rods from the camshaft. Each push rod end is equipped with a hardened, carbon steel ball, and the valve end is equipped with hardened steel rollers and pins.

The push rods are made of seamless nickel carbon unannealed steel tubing. The top end is a hardened steel socket to receive the ball at the end of the rocker arm; while the lower end is fitted with a hardened steel button seated in a roller plug, actuated by a cam. A high carbon built-up camshaft is fitted with six cams, one exhaust, one intake, and one fuel injection for go-ahead, and one exhaust, one intake, and one fuel injection for reverse. All cams are of molybdenum steel drop forged and hardened, held to shaft by taper pins.

Camshaft, fuel pump, oil pump, and water pump are all driven by spiral gears off of front end of crankshaft. All gears are hardened carbon nickel steel, except camshaft gear, which is special gear bronze. All gears are lubricated by pressure from main oiling system.

There is a reversible gear type water pump fitted with bronze rotors and a stainless steel shaft. Ample capacity is thus provided to cool the engine properly under all conditions.

A reversible, duplex gear type lubricating pump on the pressure side forces oil from the supply or filter tank to the main lubricating oil header; the scavenging side forces oil from the crankcase sump through a cooler to filter tank.

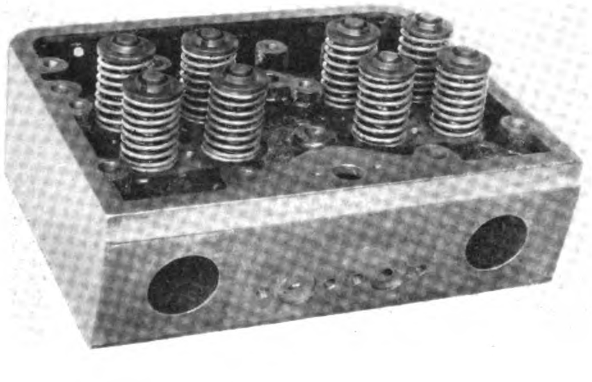
A Winton standard air starter operates on 400 pounds of air, and is efficient and reliable.

An oiling system of force-feed type insures positive and proper lubrication at all times. Oil is forced under pressure to all parts requiring lubrication. This system also insures economy of oil and cleanliness. A pump delivers oil from the oil supply tank to a header in the case, and from this header oil is delivered to all main bearings, then through passages drilled in the crankshaft to connecting rod bearings, up each connecting rod through a tube to the wrist pin sleeves and then to the wrist pin bearings in the piston. All lubricating oil drains to the crankcase sump. A second pump draws the oil from the crankcase sump, forcing it through an oil cooler and into a filter, which consists of a series of screens. Oil filter and oil cooler are of ample capacity.

The thrust bearing is an extra heavy, double row, deep groove ball bearing of ample size to absorb all thrust exerted by the propeller wheel. The bearing is bolted to the top and bottom crankcase, and is lubricated by the engine lubricating system.

Water cooled exhaust manifolds are furnished with exhaust and intake mufflers of Winton design. Flanged and bolted joints prevent leaks, insuring cleanliness.

The total weight of the engine is 7400 lb.



Valve assembly for a pair of cylinders

Cylinder, piston, cylinder liner and connecting rod

The Principles of Supercharging

(*Continued from page* 220)

without supercharging. In a 4-stroke engine fitted with the Büchi system of supercharging the power required to drive the blower is supplied by the exhaust-gas turbine. If the blower were driven by an electric motor, supplied with current from an independent generator, or if the air were supplied by pumps driven by the engine, the overall efficiency of the installation would be lower.

It would appear, from recent patents, that the supercharging of 2-stroke engines is receiving some attention, but the problem is in some respects somewhat more difficult with this type of engine than with the 4-stroke engine, particularly for high engine speeds. If there is only one source of air supply for scavenging and supercharging then to maintain the efficiency of scavenging in the supercharged engine it is necessary to create a back pressure in the exhaust ports during the scavenging period; this can be done by means of a throttle-valve in the exhaust pipe, which was the method adopted by Junkers in his experimental opposed-piston engine. A method which I proposed some years ago, and which was embodied in an experimental 2-stroke engine, was to introduce the scavenging air through ports in the usual manner and to supercharge the cylinder with air at a higher pressure through a row of ports, controlled by a mechanically-operated valve, placed above the scavenging ports. This necessitates the provision of air at two pressures.

An Automotive-type Marine Diesel*

An Important Application of the M.A.N. Design to a Small Engine for Yacht and Workboat Duties

By R. J. Broege

THE demand for and interest in small high-speed Diesels may be assessed largely to the economical operation of such engines and the lesser fire risk than that accompanying gasoline engine operations.

The data which follows is particularly confined to a type of full Diesel engine, suitable for yachts and small craft, developed in 1923, and sold in Germany to the commercial trade, proven out in actual service under private and individual ownership.

The American-built Diesel, with which this particularly deals, is built under a license and to the patents of the Maschinenfabrik-Augsburg-Duernburg, Germany, generally known as the M.A.N.

The demand for light- and high-speed Diesel engines for submarine service opened the way for construction along these lines, and advancement in the submarine engines indicated greater possibilities in other lines. One of the latest developments is the automotive type compressorless airless injection full Diesel engine of 4-stroke cycle type.

These automotive compressorless solid injection Diesel engines should, in no way, be compared with the commonly known slow-speed heavy Diesels of either the air injection or solid injection types.

The automotive high-speed Diesel has already gone through many of the stages that the present-day gasoline engine has gone through before coming to its present highly developed stage. This type of automotive Diesel engine will perform economically over a wide range of service equally as well as gasoline engines with cheaper fuel and far better fuel economy with less fire risk.

The American-built automotive type compressorless airless injection full Diesel engine, manufactured by the Buda Company, Harvey, Illinois, has 6 in. bore x 8 in. stroke. The view of the fuel pump side shows the fuel filter, fuel dividers and inlet and exhaust manifolds with the elbow for air filter application.

A view of the water pump side of the same engine shows the lubricating oil tank with sight glass, the lubricating oil dual geared type pump, with piping and filter, the crank case breather, centrifugal water pump, removable push rod cover plates and cylinder head cover and the nozzle clamps.

In the design and construction of the American built engine, no attempt was made to deviate from principles involved in the M.A.N. design. The only purpose was to make their already highly developed engine more adaptable to American standards and practices and to simplify where possible to aid service and production.

The crankcase and cylinder housing are of boxed construction cast integral en bloc for any number of cylinders. This produces a rigid and light design, making a very smooth operating engine. The cylinder proper consists of a grey iron inserted sleeve readily renewable without any difficulty. The main babbitt-lined bearings are suspended in the crankcase and secured by inserted bolts, there being a bearing between every cylinder.

The oil pan is aluminum for lightness so that it can be easily dropped for bearing adjustment as in gasoline engines. Provision has also been made for removing the pistons and rods from the bottom. However, they may also be removed through the top if desired. Hand holes are provided on the side of the crankcase for connecting rod bearing adjustment.

The crankshaft with the flywheel are balanced statically and dynamically. The flywheel is enclosed in a flywheel housing; flywheel housing being the smallest practical because of the necessity of the large flywheel to produce energy for starting as well as steady operation.

Electric starters, or a 2-cylinder air cooled double opposed gasoline engine, may be used for starting purposes, both being arranged with a gear drive automatically engaging the ring gear on the flywheel. To aid the initial turning over of the engine, a manually controlled compression release has been provided. After the engine is spinning, compression may be engaged on one cylinder until it fires, after which all cylinders may be engaged.

The valves are located in the head and are operated by rocker arms and roller push rods. The valve tappet adjustments can be conveniently made by removing the cylinder head covers which leaves the rocker arms in plain view without any accessories or other parts in the way.

The valve in the head design is desirable for obtaining the desired compression space for the most efficient pressures. The inlet valve has an integral deflector on the head which, with the angular direction of the fuel spray, produces the necessary turbulence for complete mixture of air and fuel necessary to produce clean combustion.

The cylinder heads are cast in pairs for lightness to facilitate easy removal and are protected by safety valves.

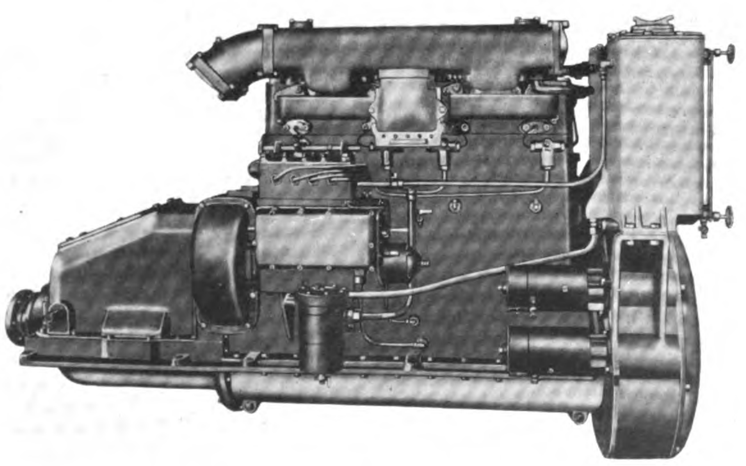
The air inlet pipe has a pre-heater attached to aid in starting under extremely cold conditions and is arranged for the application of an air filter. The exhaust pipe is large and has an outlet flange suitable for attaching a muffler.

All parts are completely enclosed but are readily accessible by removing the hand hole plates, push rod covers, or cylinder head covers, the latter two being held by one hand nut each. Cooling is accomplished by the conventional water pump of centrifugal type driven off the gear train. Provision is made for the generator drive off the extended water pump shaft.

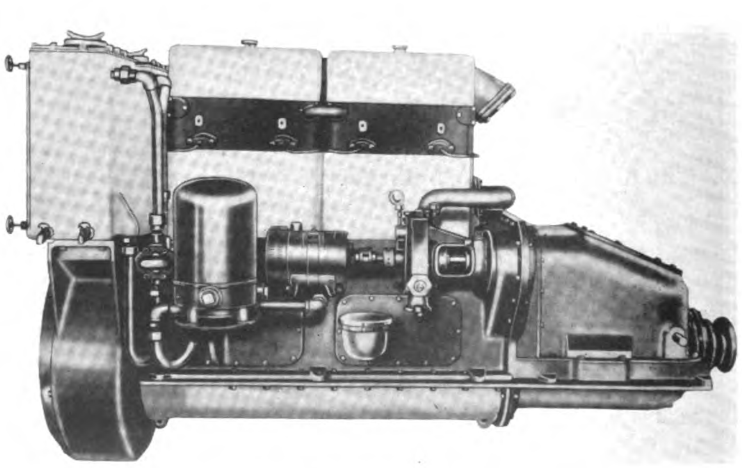
Forced-feed lubrication to all moving parts is a feature. This is done by a dual geared pump operating a dry sump system. Oil is taken from the supply tank mounted on the flywheel housing from where the pressure pump forces it through the filter to the main and cam shaft bearings. From the main bearings, it goes to the crank pins and up the drilled connecting rods to the wrist pins. It is also forced to the rocker arm assembly and to the fuel pump. The timing gears are lubricated by a jet of oil directed to each pair at the point where the gears mesh. The oil from the main bearings and all other moving from which the sump pump returns it through parts drains to the bottom of the sump pan a screen to the supply tank. Mechanical lubrication of the pistons has also been provided for if desired. The constant oil pressure is maintained and protected by safety valves. All oil passes through screens before entering the pumps and then the filter before it reaches the moving parts. The dry sump system helps to

* Being the substance of a paper presented by R. J. Broege, Chief Engineer, The Buda Company, Harvey, Ill., before the Society of Automotive Engineers at Detroit, Mich.

(Please turn to page 263 for continuation)



Shows exhaust manifold and fuel tank of the engine



The Buda-M.A.N. Diesel is characterized by sturdiness and simplicity

Biggest Opposed Piston Diesel Tanker

A 24,000 ton Displ. Bulk Oil Freighter, Built in an American Yard Completed by the Sun Shipbuilding Co.

ONE of the most definite features in ship construction reviewed over a period of the last 18 months or so has been the tremendous increase in bulk oil freighter, or "tanker" construction. This has been particularly the case with motor tankers. In fact it is safe to say that the majority of tankers building today are Diesel propelled. In America especially there has been great activity in this direction as current returns show.

The Sun Shipbuilding Company, Chester, Pa., has had as much experience as any one in the country in this direction and has completed some important ships all of them powered with the well known Sun - Doxford engine. The Sun Company is the licensee in the United States for the Doxford engine.

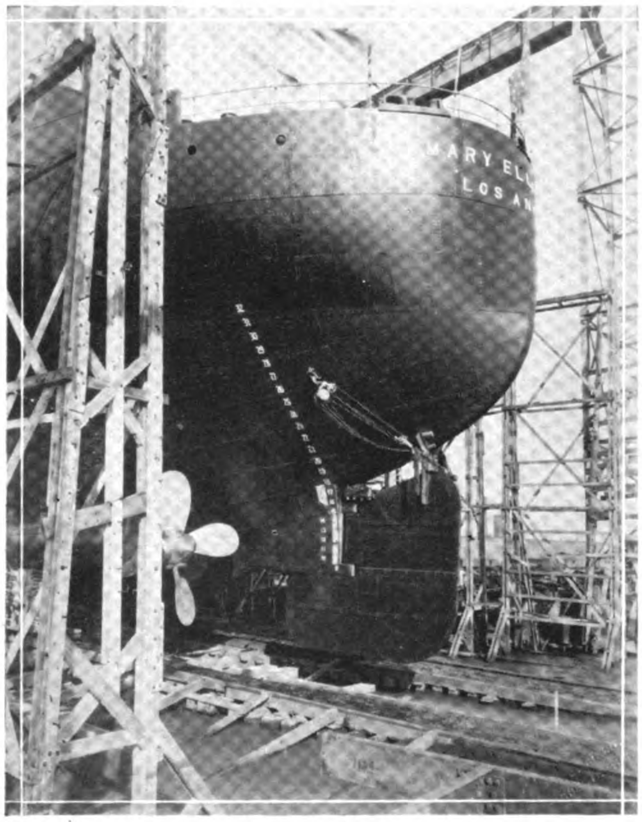
It was with interest, therefore, that the shipping world noted the big contract placed, by the California Petroleum Corporation of Los Angeles with the Sun Shipbuilding and Dry Dock Company of Chester, early in March of last year for a large motor tanker—the MARY ELLEN O'NEIL, which was launched on January 23 and on which highly successful acceptance trials were carried out on February 21.

The MARY ELLEN O'NEIL is a twin screw, cruiser stern ship built on the "Isherwood Bracketless" system, with the dimensions shown below.

The hull, built to the highest classification under American Bureau of Shipping rules and inspection, has a straight stem, cruiser stern, with poop, forecastle, and house amidships, all connected by a fore and aft gangway on the centerline of the ship, 2 masts and 2 kingposts in way of the pump-room (each fitted with two—five ton booms) and cargo oil loading and discharge nozzles. The hull arrangement follows modern conventional bulk oil carrier practice, i.e., miscellaneous cargo hold forward, main and summer cargo tanks amidships with a bunker oil tank at either end, one cofferdam separating No. 10 and

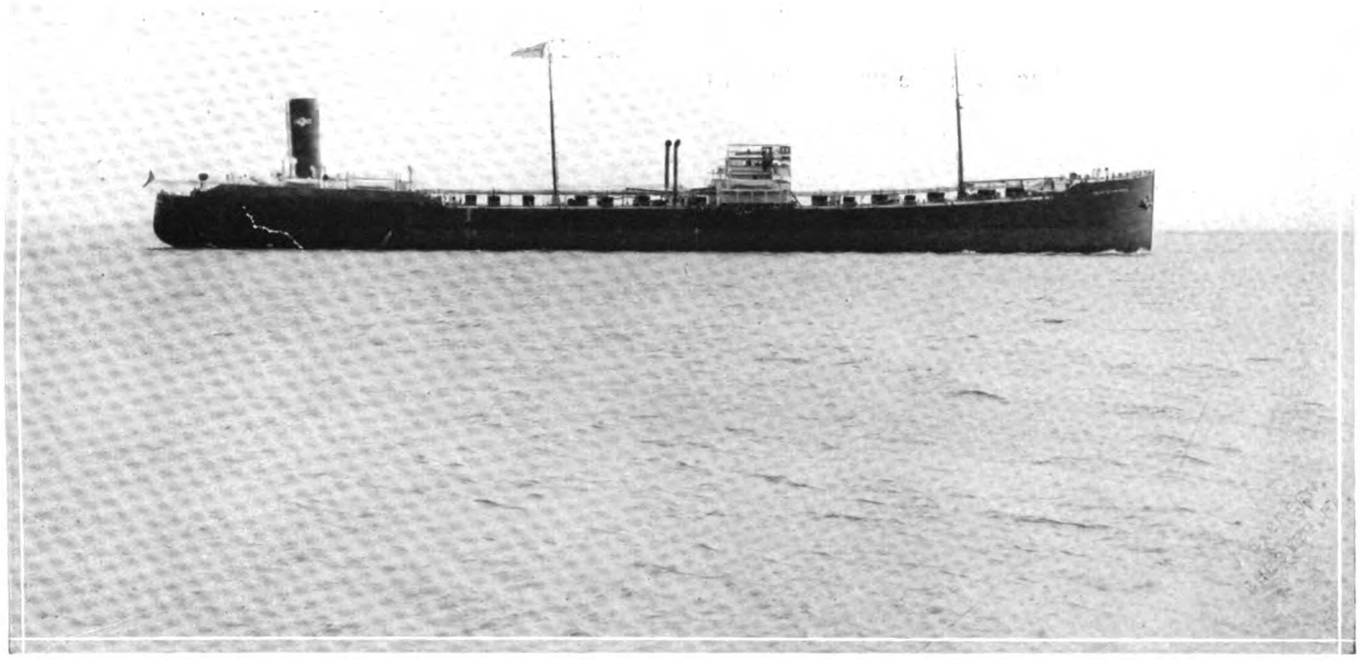
Characteristics of Ms. Mary Ellen O'Neil

Length overall	530 ft. 4 in.
Length on water line	528 ft. 6¾ in.
Beam molded	70 ft. 0 in.
Depth molded	40 ft. 0 in.
Designed draft	29 ft. 6 in.
Displacement (mld.)	24,000 tons
Cargo tank capacity (about)	5,900,000 gals.
Fuel oil	1500 tons
Deadweight carrying capacity	16,850 tons
Cargo hold capacity	78,095 cu. ft.
Speed	11½ knots
Power	5,000 i.hp.

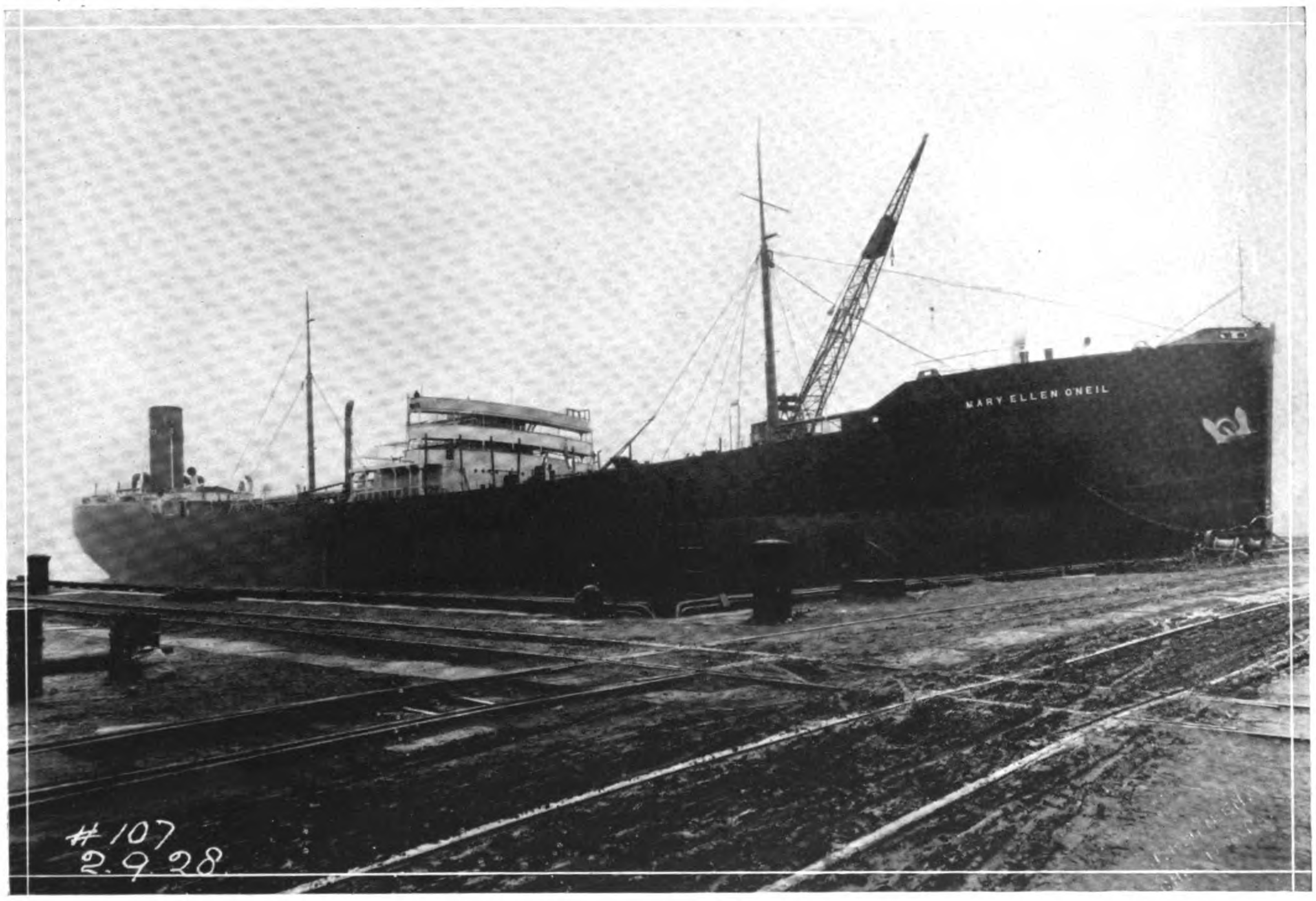


A special balanced rudder is fitted

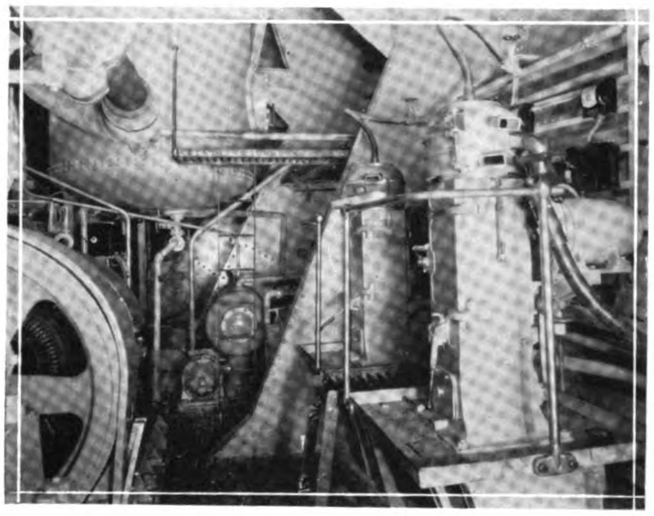
Forward end of the ship from bridge



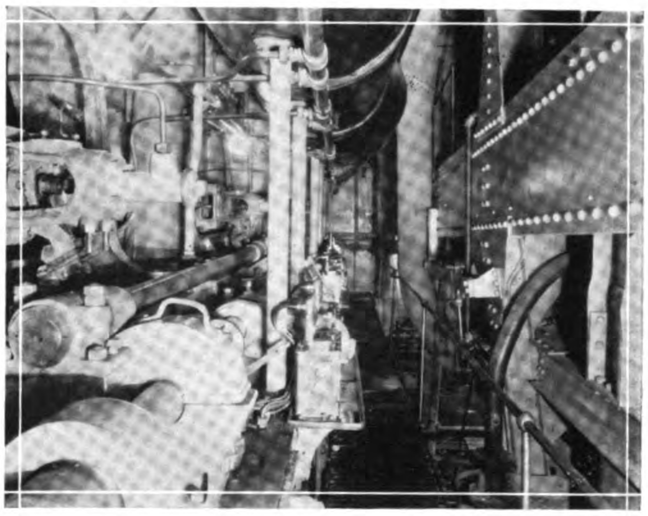
Ms. Mary Ellen O'Neil developed 5100 i.hp. at 85 r.p.m. and 12.26 knots on her trial trip on February 21



Launched on January 23, the large motor tanker Mary Ellen O'Neil was speedily completed in the fitting out basin



A batch of National Acme oil seperators



Center outboard platform with Manzel lubricators

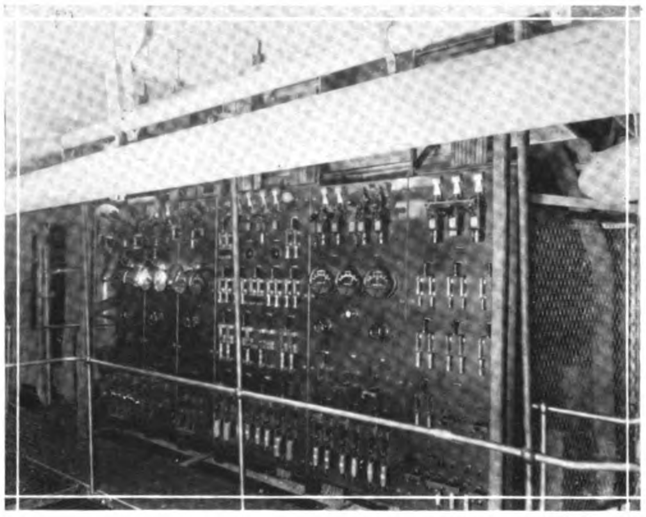
the aft fuel oil bunker, another No. 3 and No. 4 tank. Pumproom, is midships between No. 6 and No. 7 tanks and machinery aft. The O. T. centerline bulkhead extends from the forward hold to the machinery space and in conjunction with the transverse bulkheads, divides the oil cargo space into 20 main tanks and 12 summer tanks.

The deck machinery consisting of a windlass underneath the forecastle deck, two capstans on the forecastle deck, three deck winches, one at the foremast, one at pumproom king posts, one at the main mast and two capstans on the upper deck at the stern. The hydro-electric steering engine is located in the extreme stern and actuates a semi-floating stream line balanced rudder.

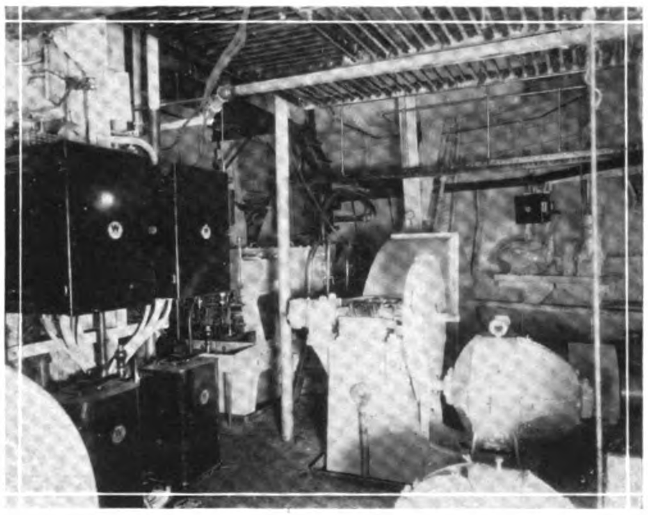
Crew accommodations are divided between the 'midship house and poop, the forecastle being devoted to carpenter and boatswain stores. The 'midship house is a three tier superstructure; the upper or navigating bridge is arranged for a wheel house and chart room with a flying bridge above. The next, below, contains the captain's quarters, consisting of a large office, stateroom, bath and lobby all panelled and finished in mahogany. The lowest tier is devoted to the stateroom for the deck officers, radio, hospital and a smoking room or lounge in place of the usual mess room. This room is also panelled and finished in mahogany, and is arranged with tables, bookcases, easy chairs and has a pantry adjoining.

In the poop and deck below are the accommodations for the Engineers, Petty Officers, Crew and Stewards departments. The Chief Engineer has a suite on the forward starboard side, consisting of an office, bath and stateroom, all panelled and finished in mahogany. The remaining engineers have large single rooms fitted with wooden berths, lockers, transoms. On the centerline, just aft of the engine hatch, is the galley and as can be seen from the arrangement plan, the officers mess, petty officers mess and crews mess rooms are also closely adjoining the galley; the whole arrangement aiming and achieving convenience in the messing service. The cold storage rooms are on the deck immediately below and as the ship has been designed for long voyages, this compartment has been made larger than usual, about 3,000 cu. ft.

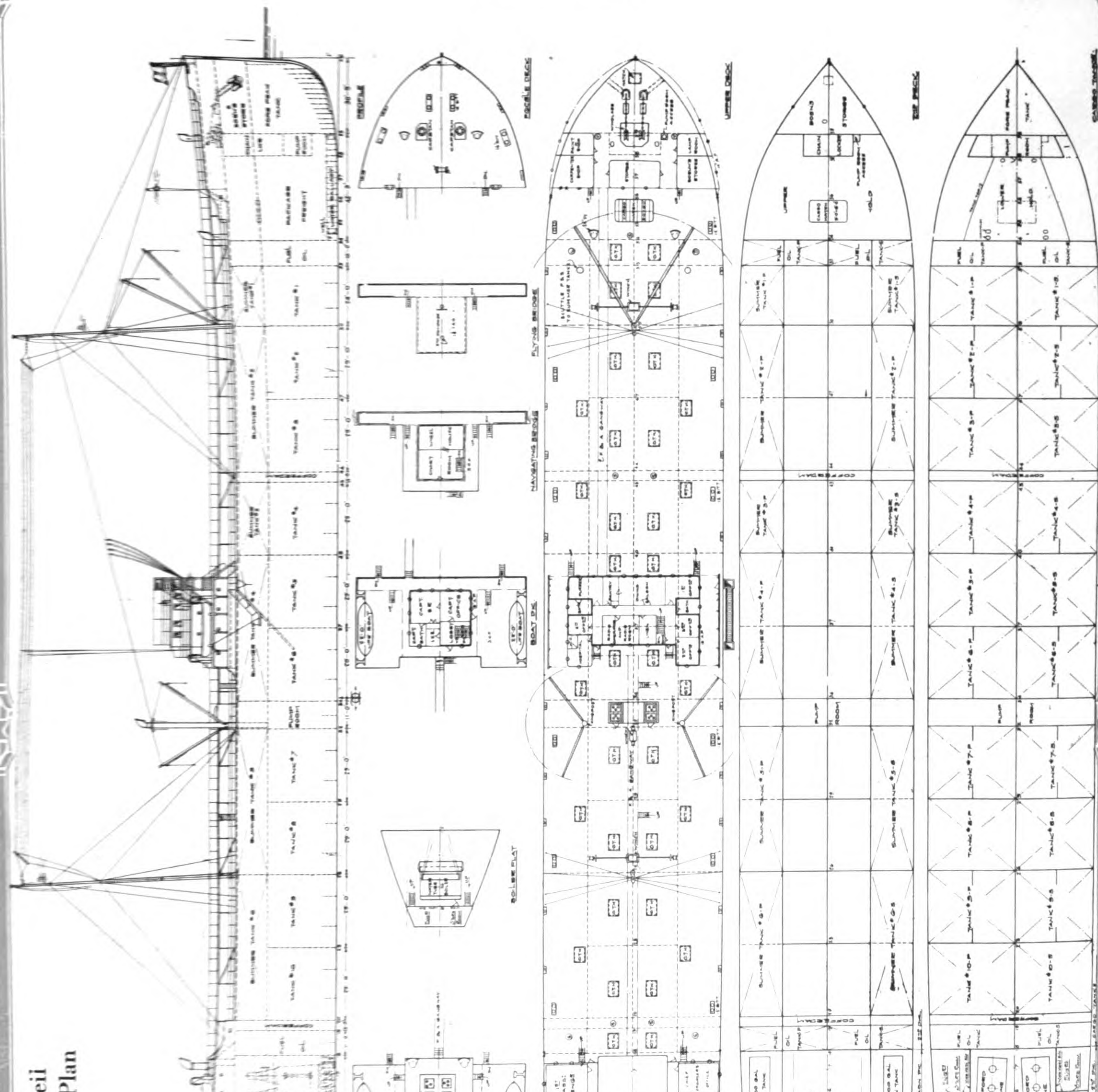
The vessel's maiden voyage will be transatlantic under the command of Captain Armstrong. Her chief engineer is Mr. Langer. On her trial trip a speed of 12.26 knots was made. It is to be noted that the contract calls for 11.5 knots service speed.



Large switchboard in main engine room

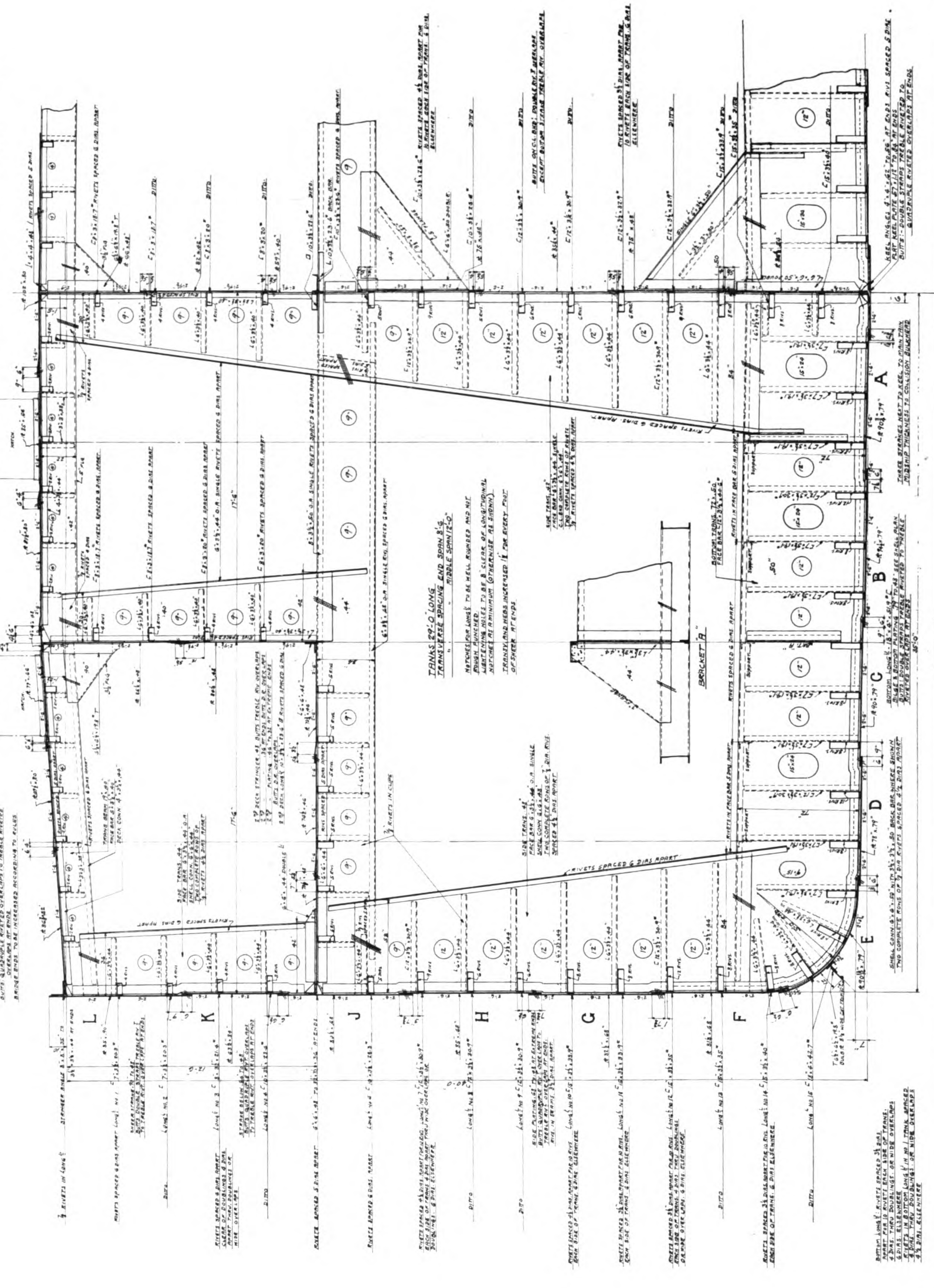


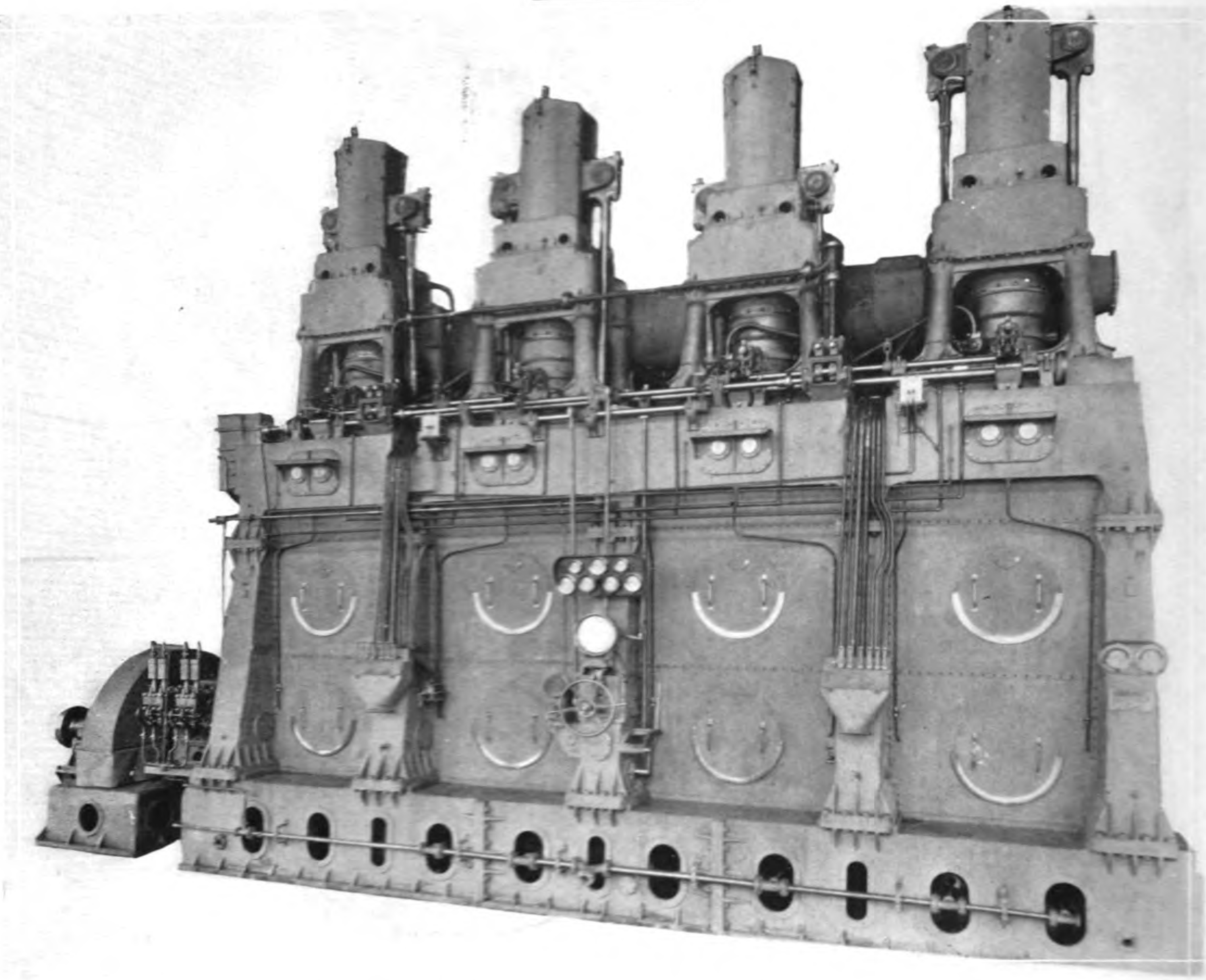
Turning gear for one of the main engines



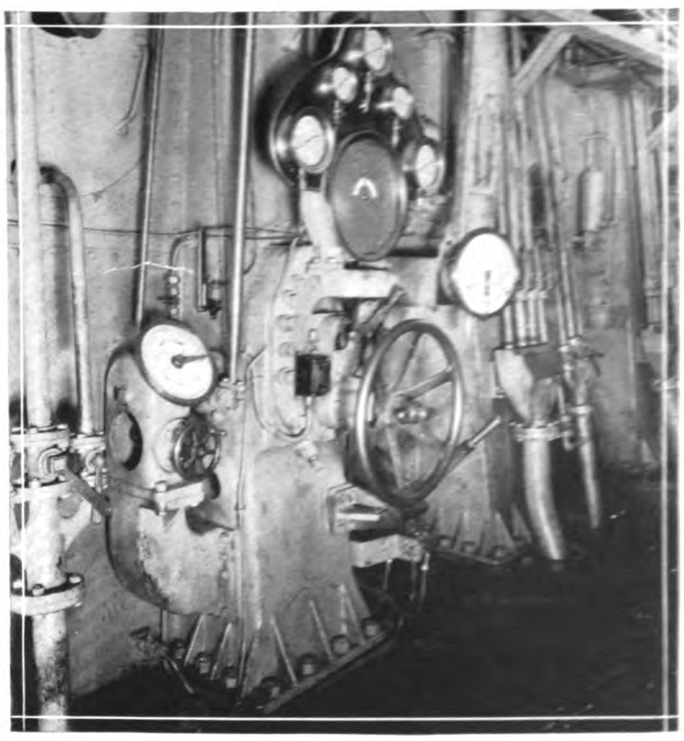
Ms. Mary Ellen O'Neil
General Arrangement Plan

Ms. Mary Ellen O'Neil Constructional Midship Section

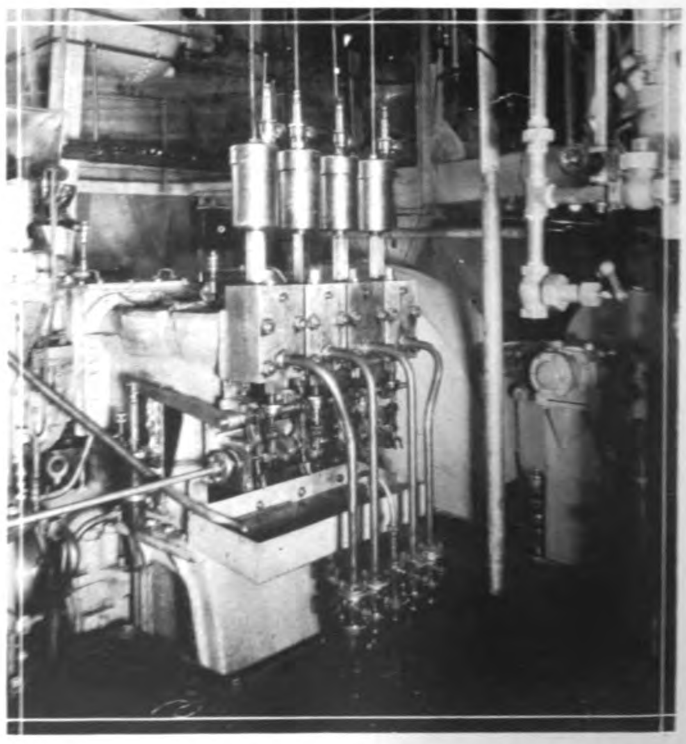




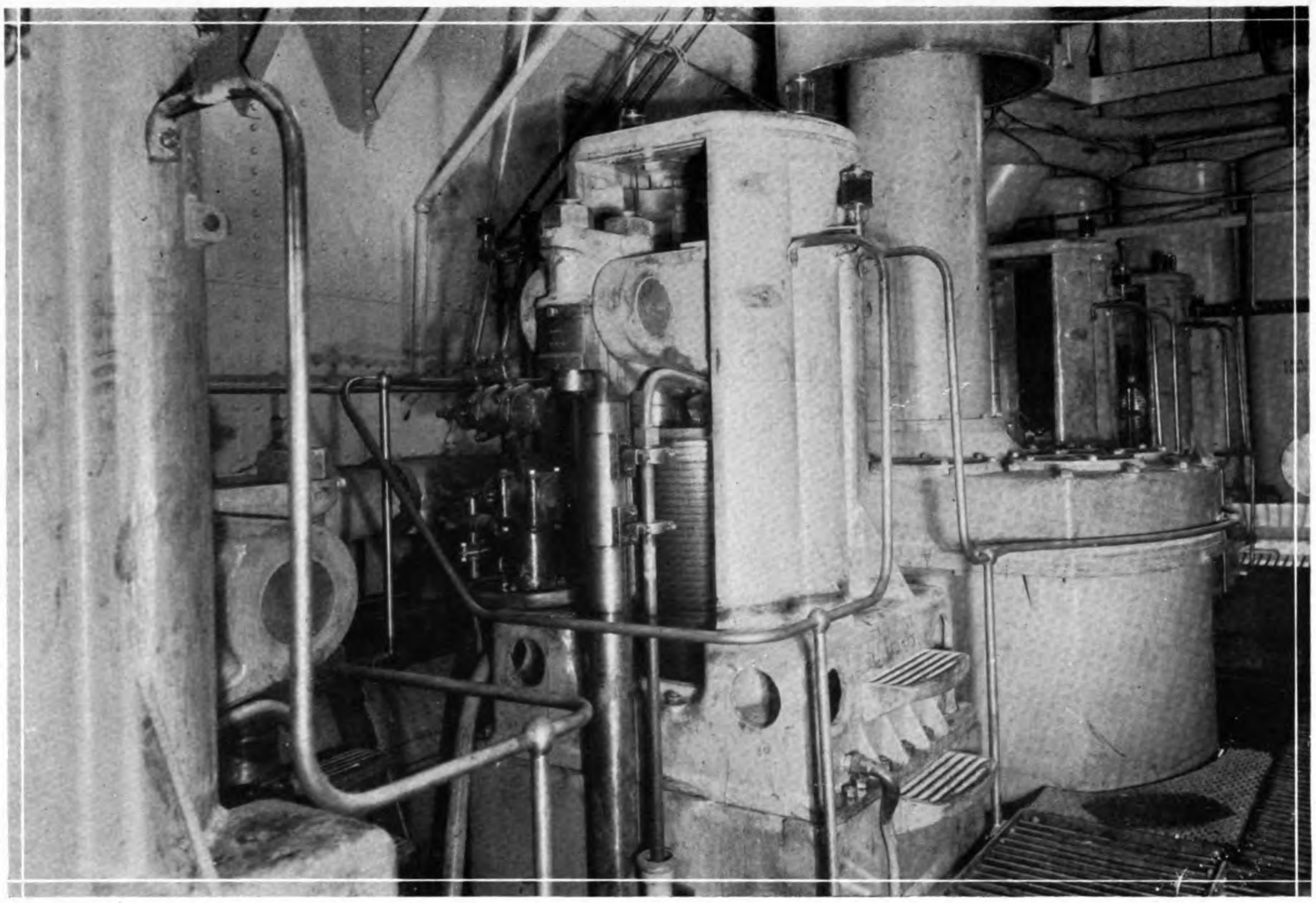
A 4-cylinder Sun-Doxford Diesel. This engine has separately driven scavenging arrangements



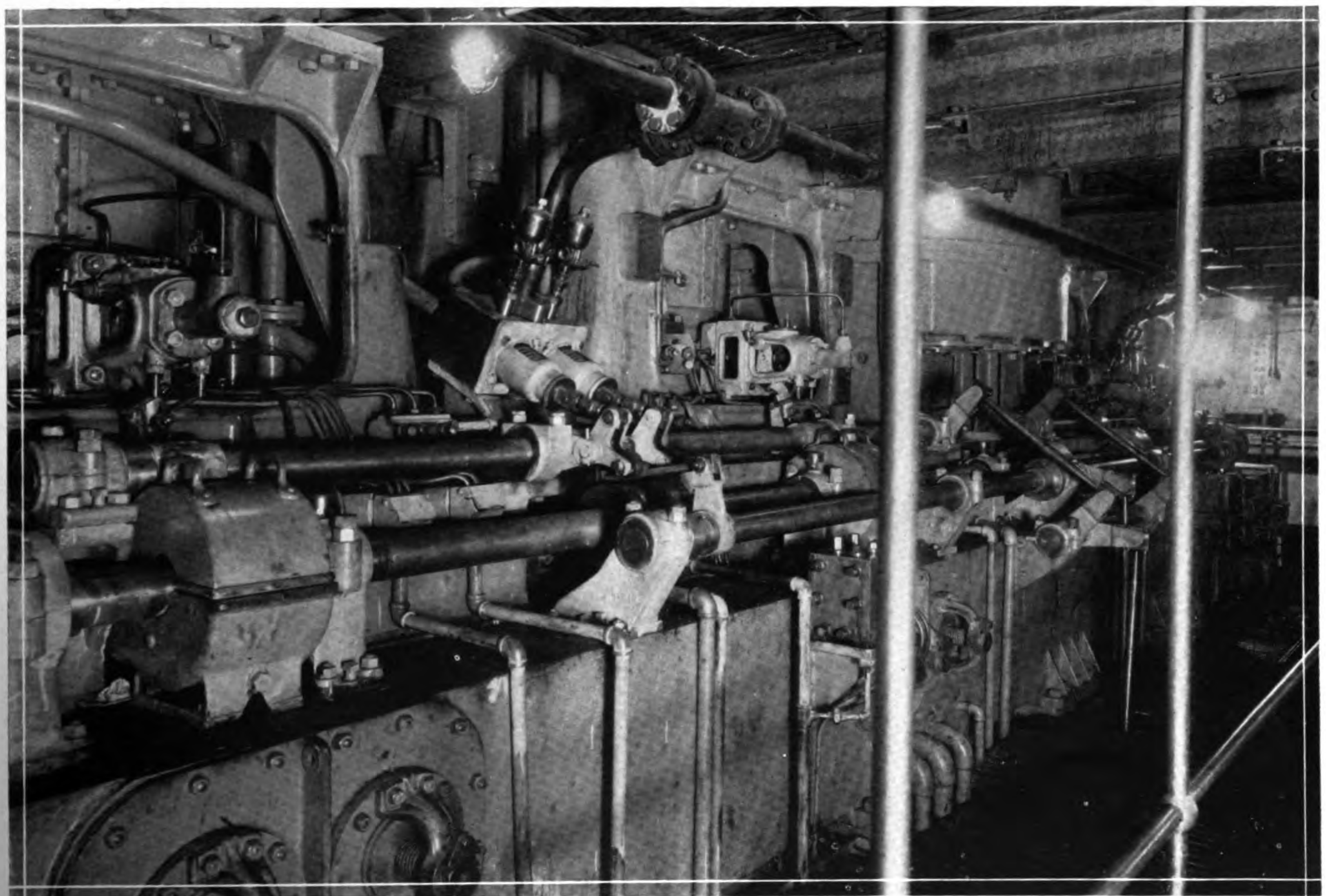
Control position of the Mary Ellen O'Neil's starboard engine



High pressure fuel pumps of the port engine of the new tanker

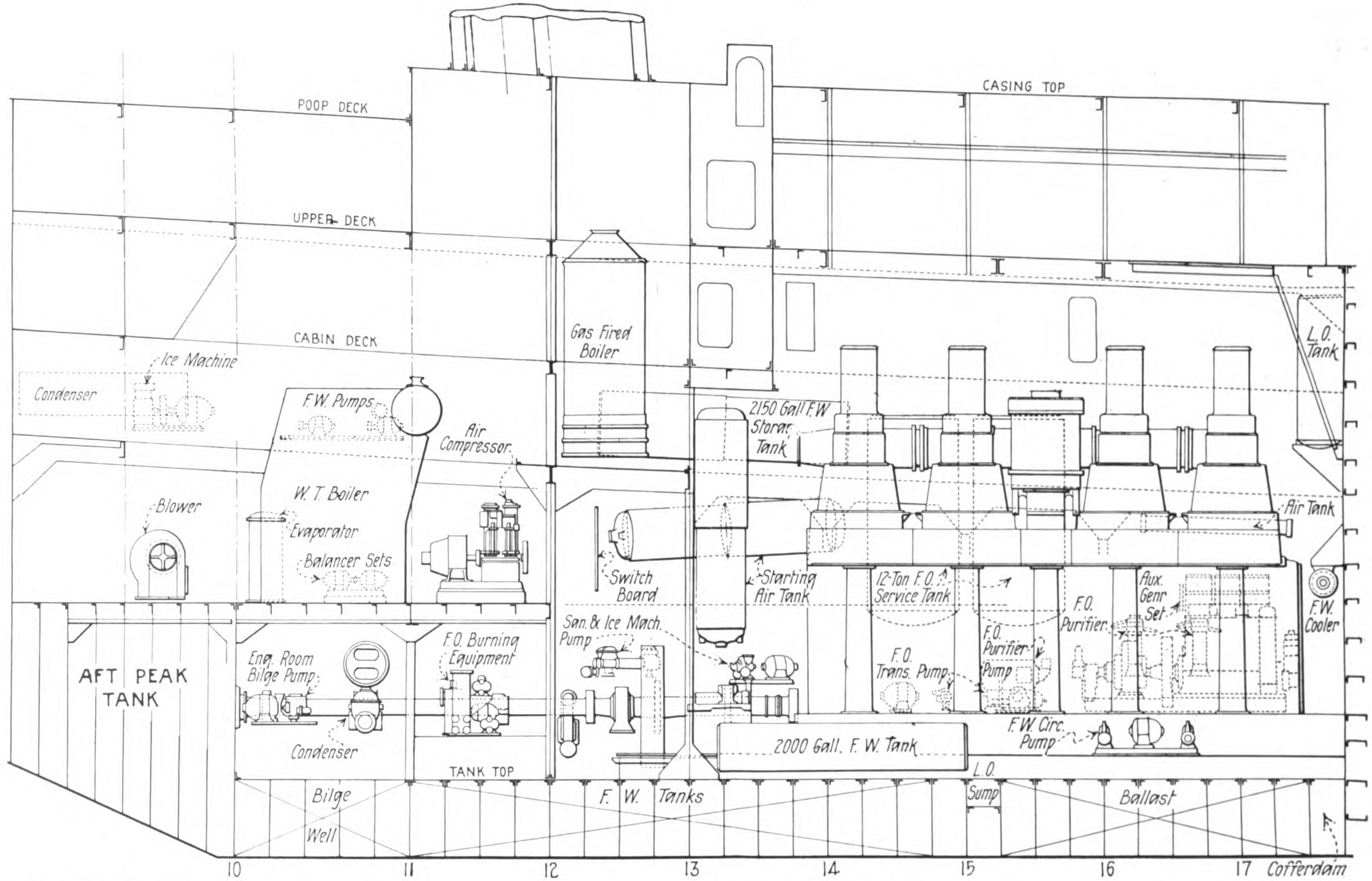


Cylinder top and scavenge pump of the port main engine of the tanker Mary Ellen O'Neil

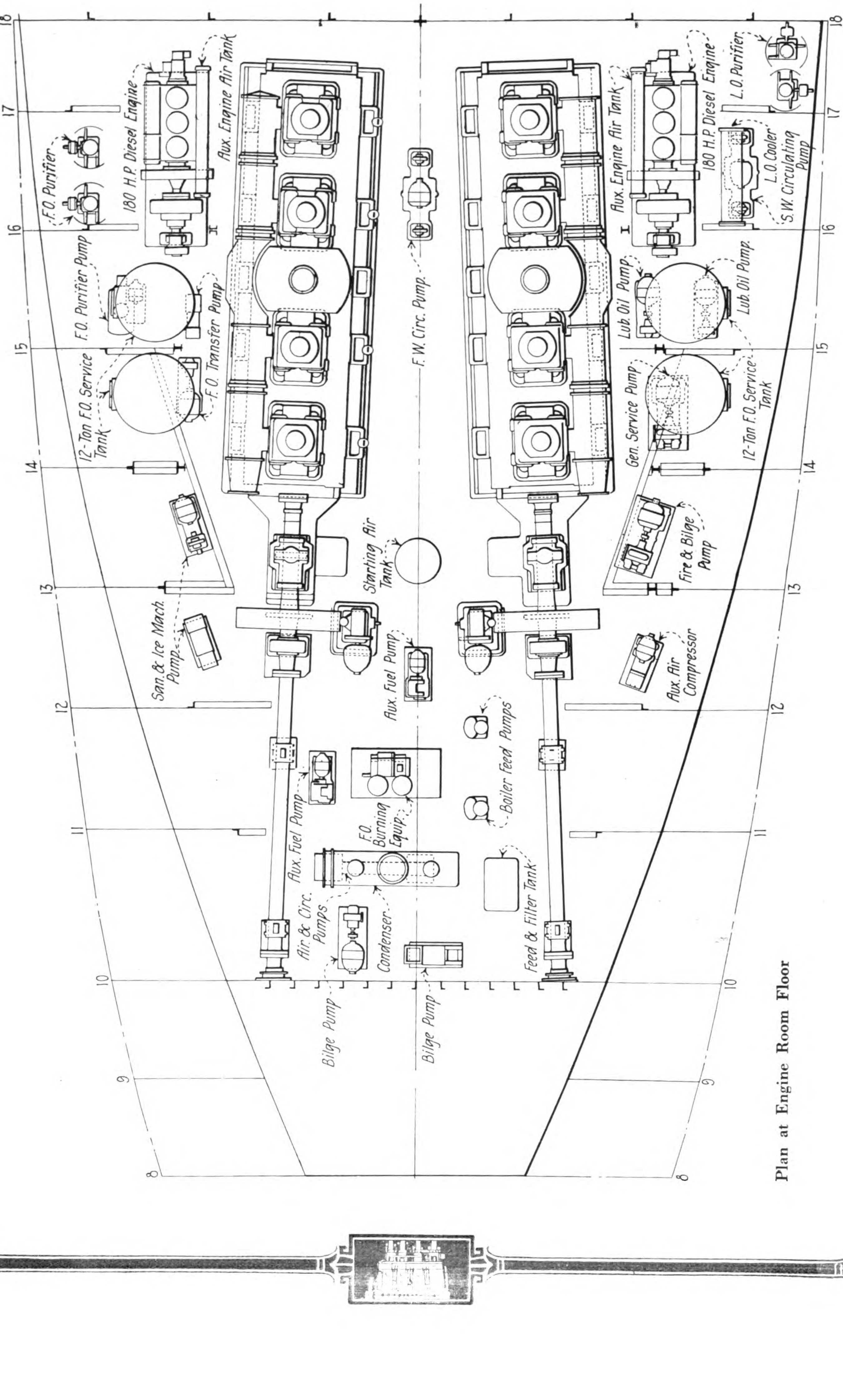


Center platform in the engine room showing camshaft and fuel valves of one of the main Sun-Doxford Diesels

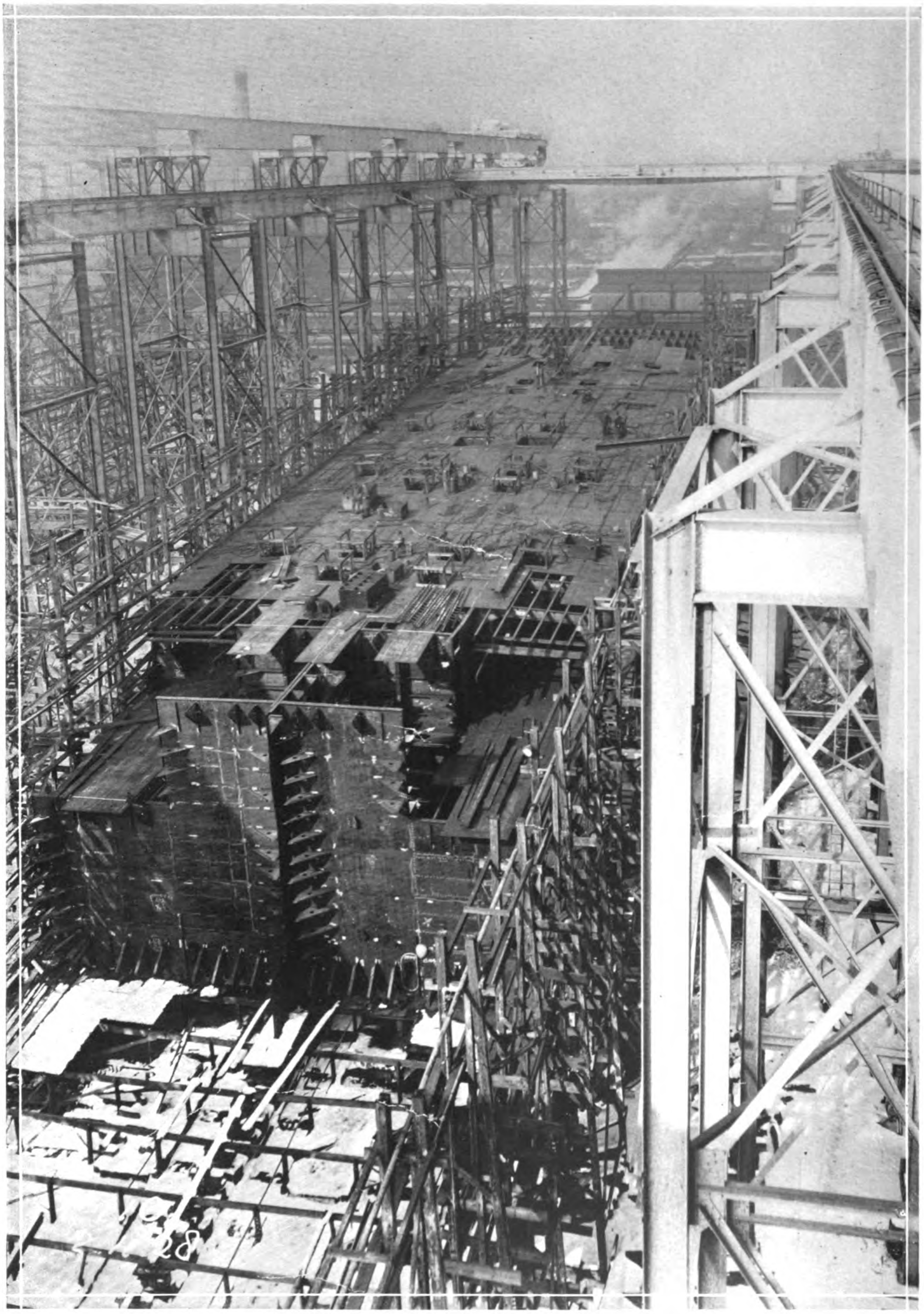
Machinery Arrangement of the California Pet. Co.'s Tanker Mary Ellen O'Neil



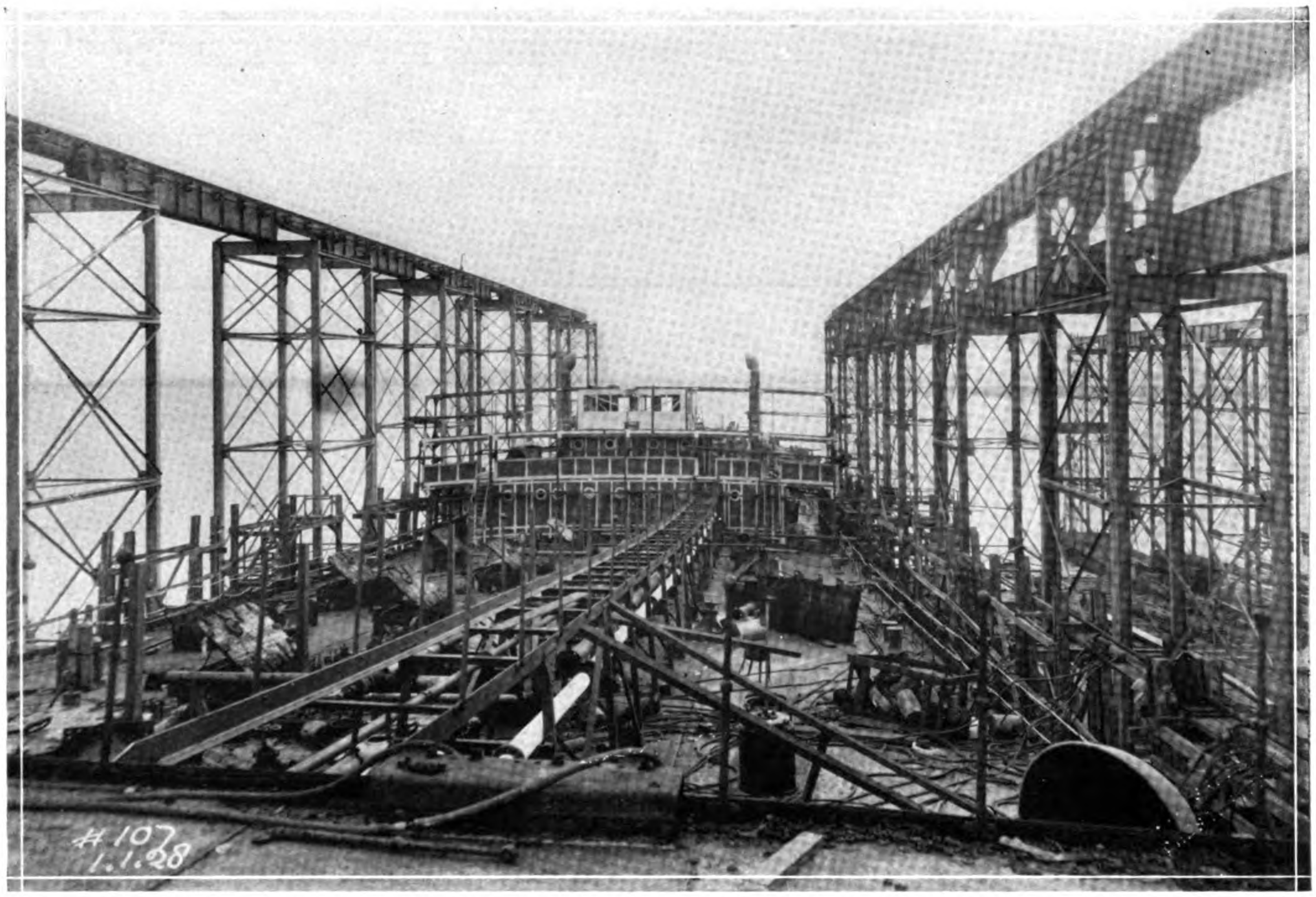
Elevation at Centerline



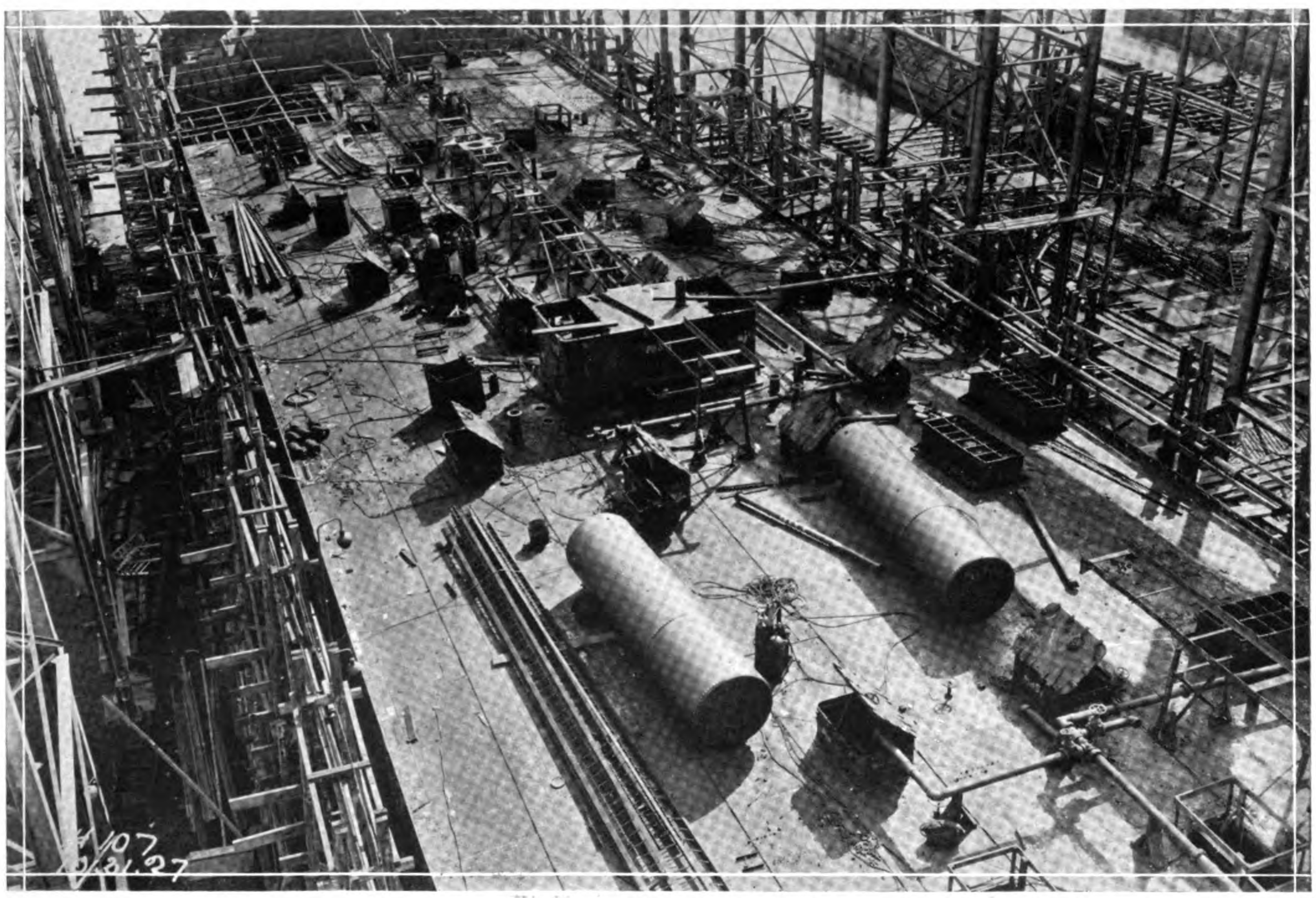
Plan at Engine Room Floor



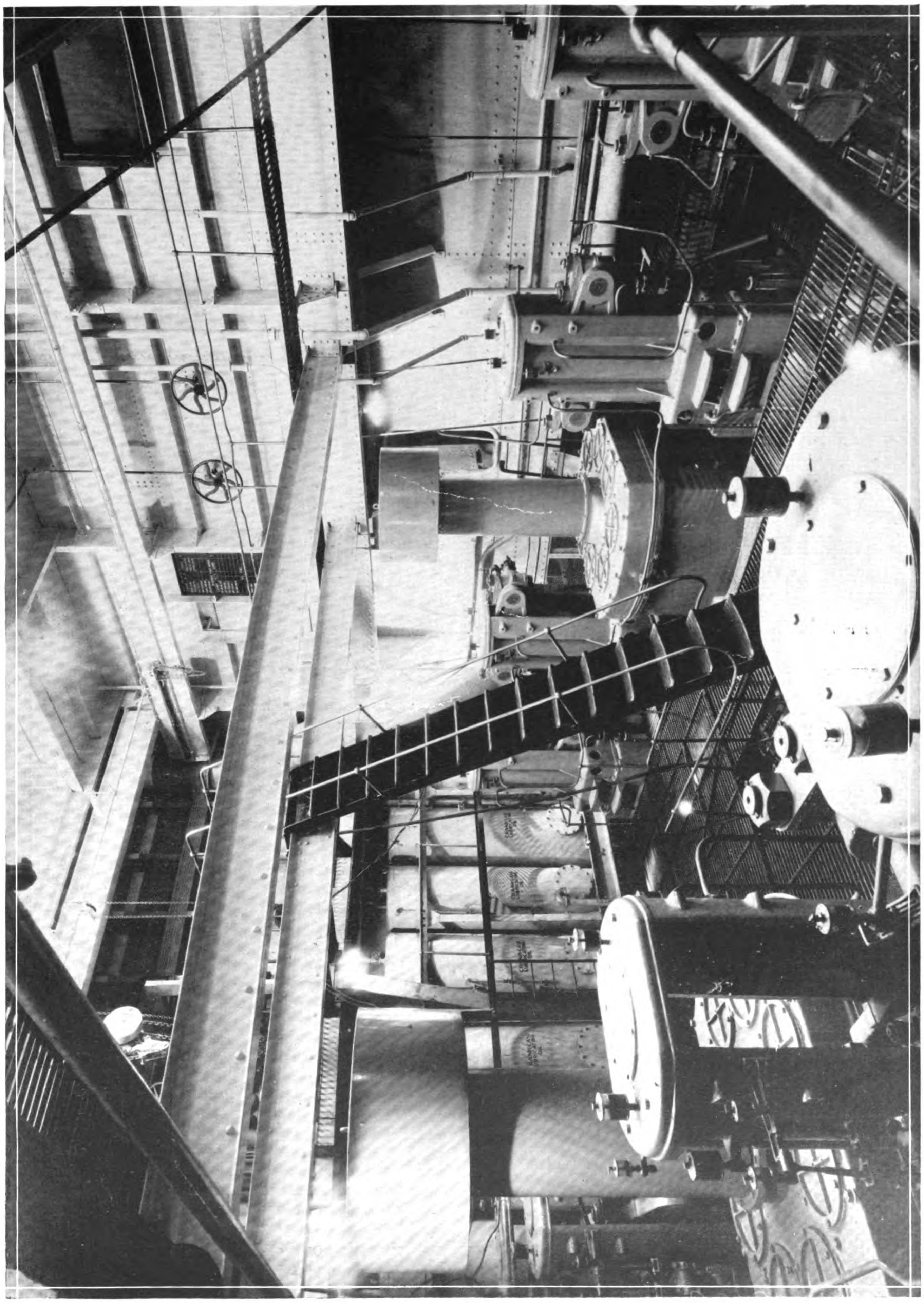
Sun Sb. Co. are experts in tanker construction. This shows a large Isherwood type motorship under construction for the Sun Oil Co. and gives a good idea of the facilities of the yard



Progress work on the big tanker Mary Ellen O'Neil at the Sun plant Chester, Pa. This shows deck work finishing



Framing almost completed and a start being made with some of the superstructure erections



A characteristic Doxford engine room is that of the big California Petroleum Co.'s tanker Mary Ellen O'Neil. Each engine is a 4-cylinder opposed piston airless injection unit. The scavenge pumps can be seen between each pair of cylinders

Ms. Mary Ellen O'Neil's Machinery

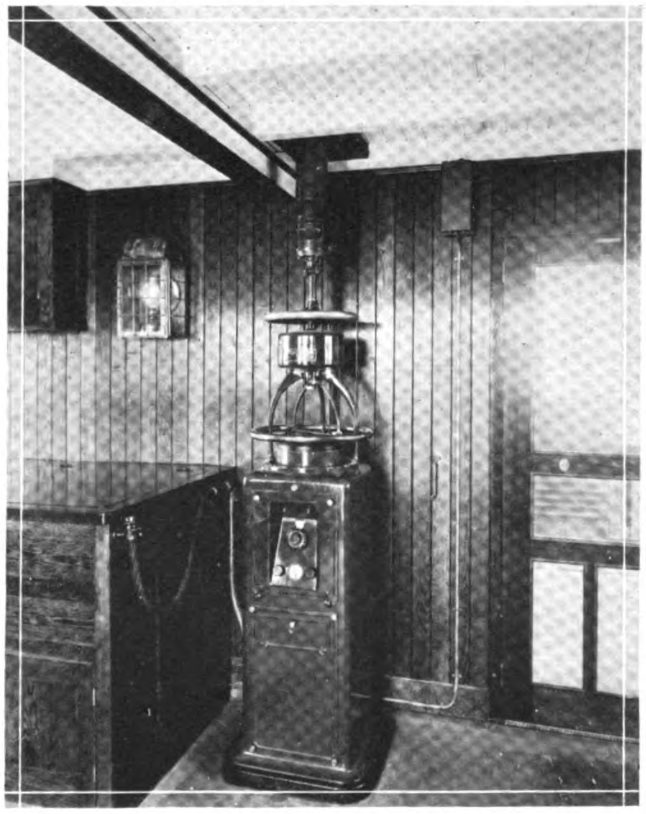
Twin Opposed Piston Diesels Make a Neat, Compact, Machinery Layout in Stern of Ship

THE MARY ELLEN O'NEIL is engined with two Sun-Doxford, opposed piston, Diesels developing a total of 2,100 s.hp. at 82 r.p.m. Each engine has four power cylinders of 21.26 ins. in dia., and the two pistons in each cylinder have a combined stroke of 85 inches, with a scavenge pump direct connected to the crankshaft between each set of 2 cylinders. By installing the center crosshead guide on the columns, together with other changes, an 11 per cent saving in weight has been effected over the previous design. The engines work on the 2-cycle, opposed piston system; each lower piston operating the center crank, while the two side cranks are operated by the upper pistons through a transverse beam and twin rod mechanisms. Fuel is injected by means of a pump at the after end of the engine, at a pressure of from 1,500 to 10,000 lb. per sq. in., depending on the revolutions required.

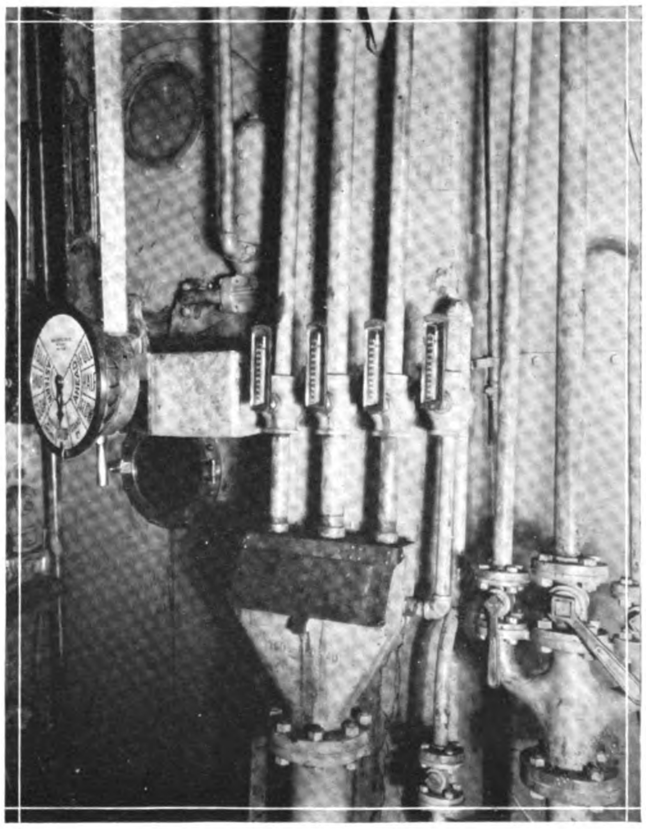
Three starting air tanks, each having a capacity of 150 cu. ft., provide enough air for from 18 to 20 starts without replenishing. Fresh water is used as the cooling medium for the pistons, valves and cylinder jackets, and as the water returns to a tank after coming from the pistons, etc., the loss is very small. Salt water is used for cooling the guides, and forced lubrication system is used throughout.

Each cylinder of these engines, contains two diametrically opposed fuel valves, actuated by levers operated from cam shafts; a starting air valve; a relief valve; a brake valve; and an indicator cock. Through the use of the brake valve, only 37 sec. are required to change from an ahead running condition to an astern running condition. The exhaust manifold of each engine is piped to a butterfly valve, which controls the passage of the hot gases to either an exhaust gas heat exchanger or the stack. These heat exchangers, of which there is one for each engine, are cylindrical in shape and stand in a vertical position aft of the main engines. Both have 1,630 sq. ft. of heating surface, and provide sufficient steam for heating the quarters and other sea going requirements.

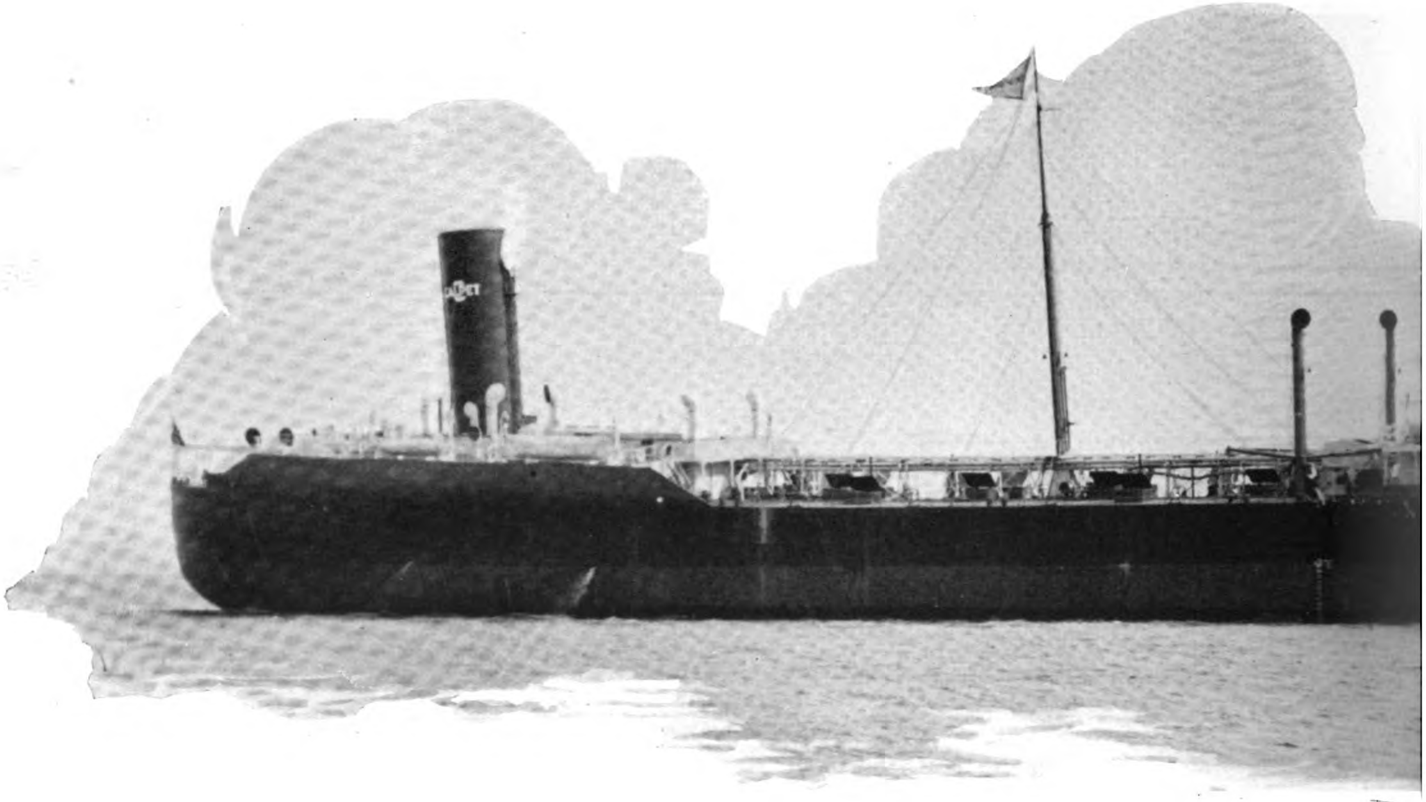
Airless injection of fuel is employed on all Doxford and Sun-Doxford type engines. Fuel is atomized into the combustion space through two diametrically opposed fuel valves. To maintain the high pressure without a pressure drop during the period of injection requires powerful pumps and a considerable volume of fuel in the lines. The four fuel pumps are geared to the engine abreast of the thrust block, where they are in a very accessible position for inspection and maintenance. Each pump chamber is machined out of a solid



Kolster radio compass in the chart room



Thermometer group on the cooling water system



M. T. MARY ELLEN O'NEIL

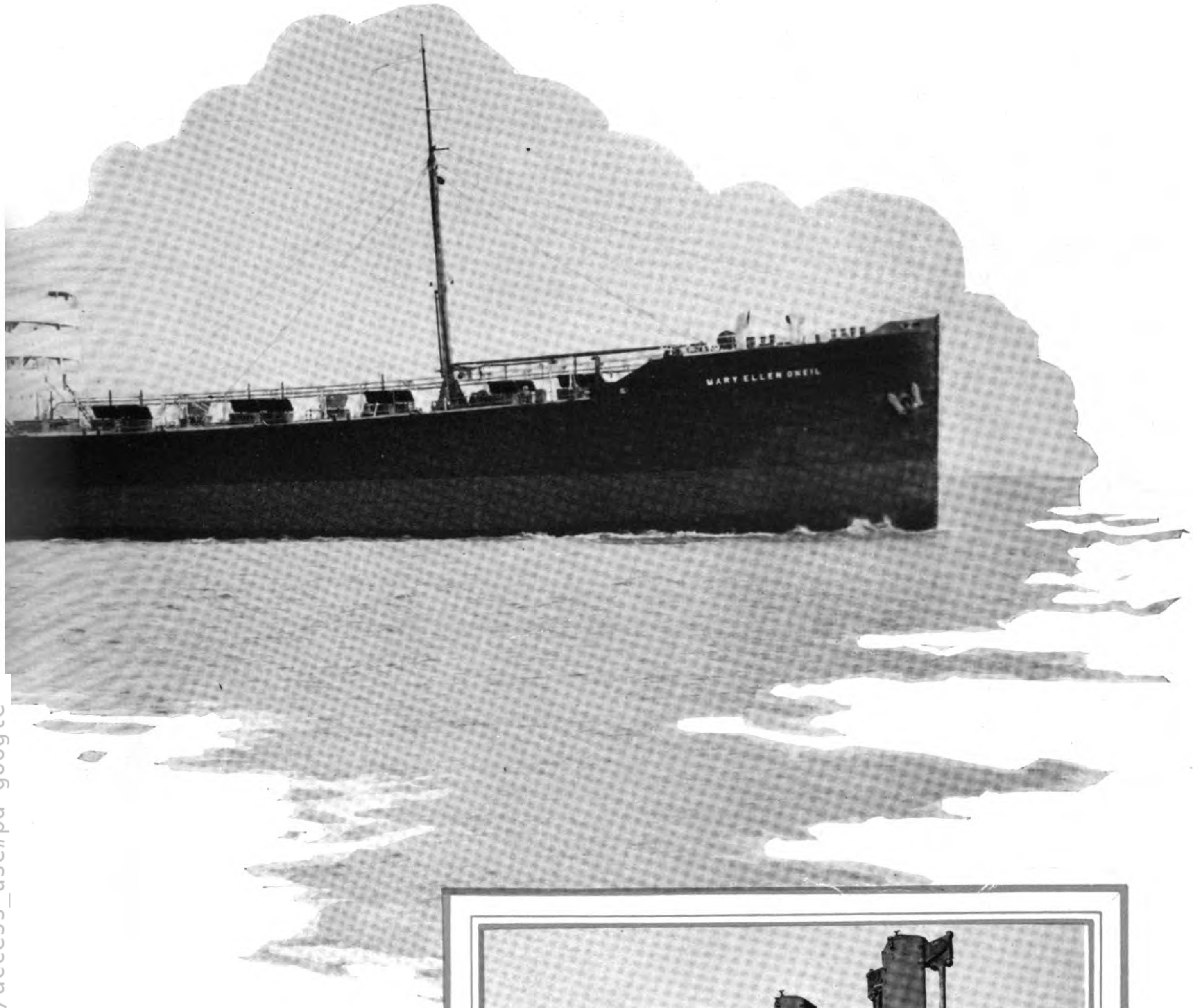
THIS Diesel-driven tanker is one of the finest vessels of her type completed for the American merchant marine. She is the largest motorship to be Diesel-engined as well as built entirely by an American shipyard. She was designed and constructed by us for the California Petroleum Steamship Corp. of Los Angeles, Cal., under the supervision of this oil company's marine department.

Dimensions:

Displacement	24,000 tons.
Deadweight Capacity	16,850 tons.
Cargo Capacity	6,000,000 gal.
Power	4,200 s.hp.
Length on W. L.	530 ft. 0 in.
Breadth	70 ft.
Depth	40 ft.
Draft	29 ft. 6 in.

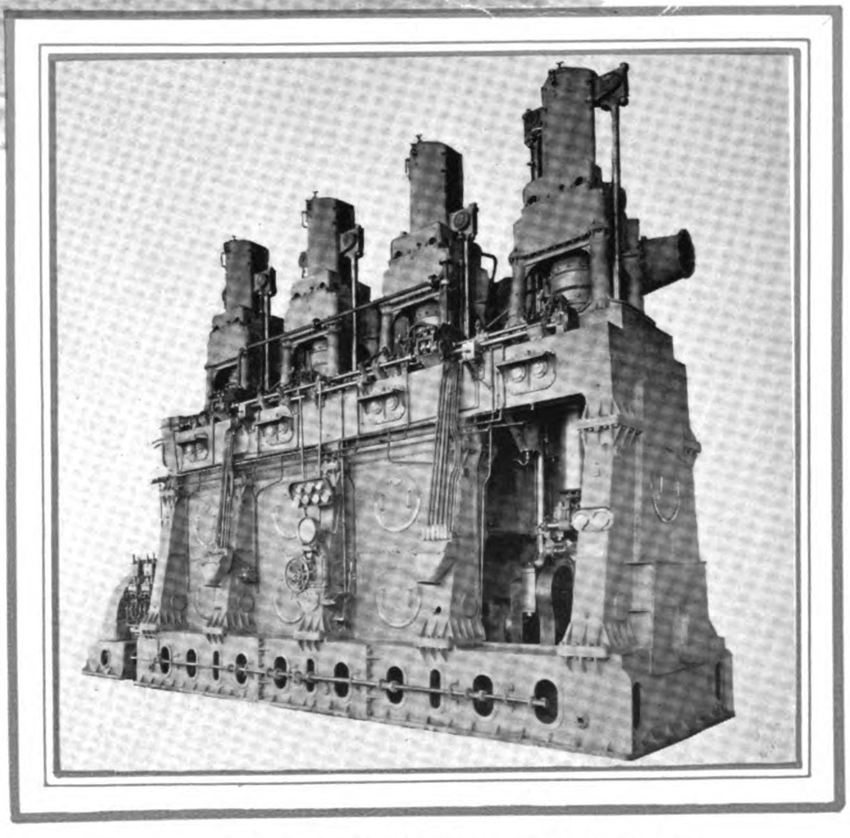
SUN SHIPBUILDING AND DRY DOCK CO.,

Shipyard and Main Office: Chester, Pa.

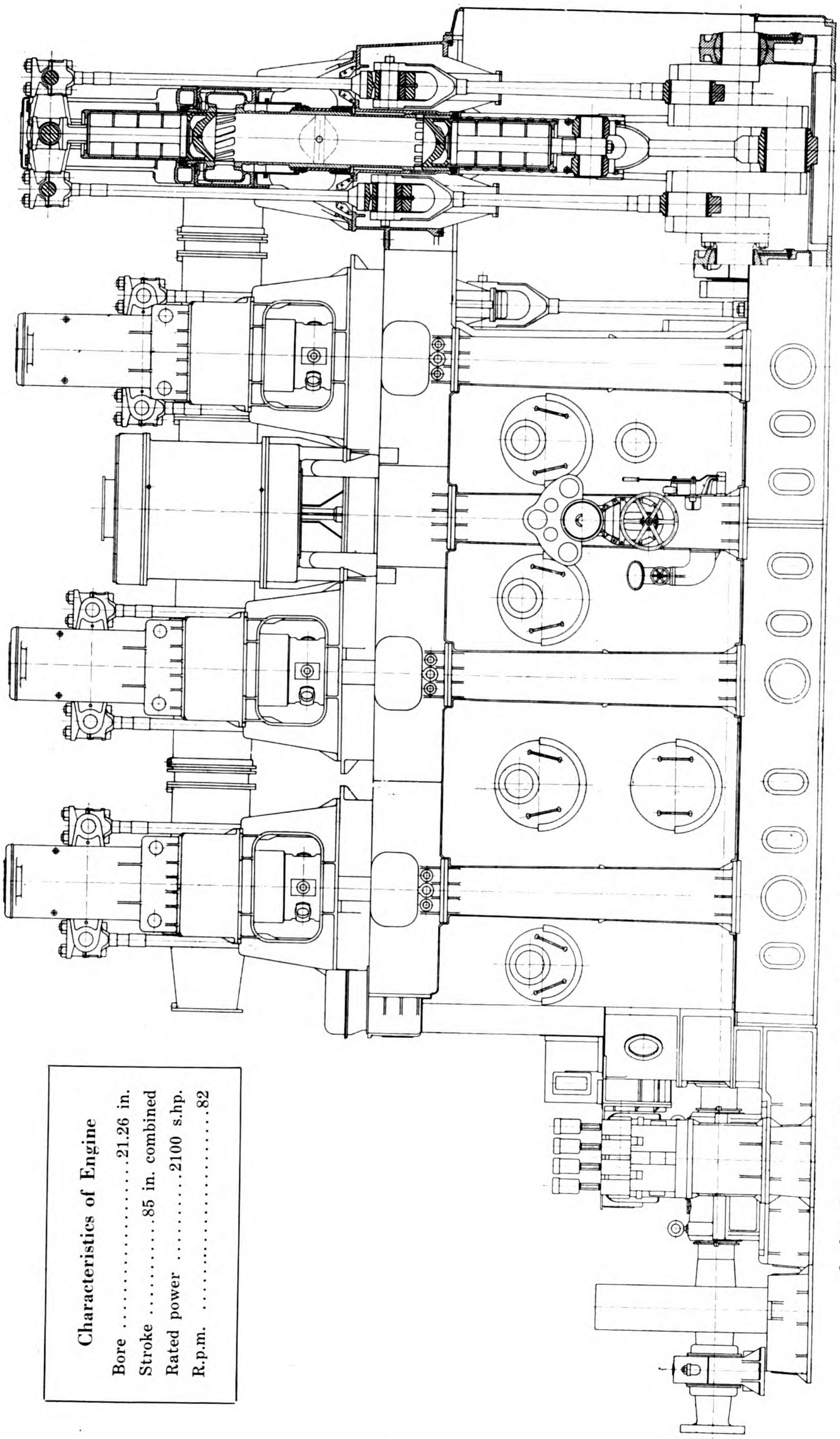


MAIN ENGINES

The Mary Ellen O'Neil is powered with two 4-cylinder, 2100 s.hp. Sun-Doxford opposed-piston Diesel engines, 21¼" bore, 2x42½" stroke. Their rated power is developed at 82 r.p.m.



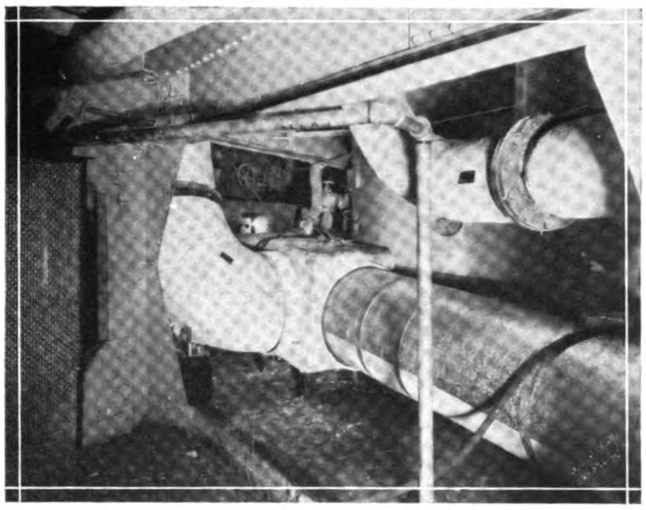
Cylinders 21¼" Dia. by 2x42½" Stroke



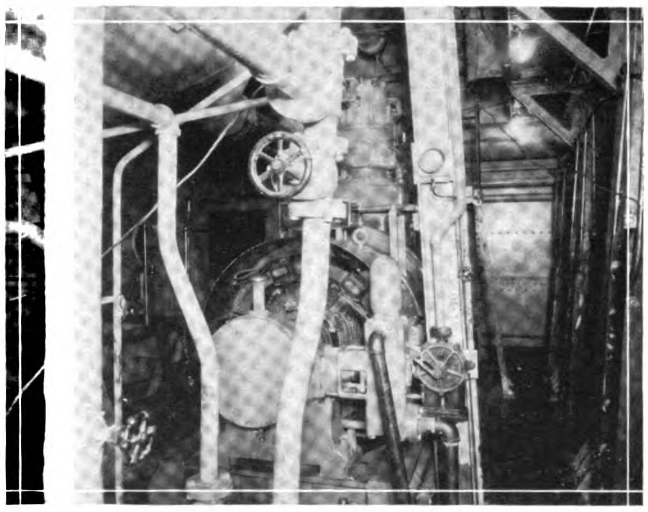
Characteristics of Engine

Bore	21.26 in.
Stroke	85 in. combined
Rated power	2100 s.hp.
R.p.m.	82

Outboard profile and sectional view of one cylinder of one of the main Sun-Doxford Diesels of the motor tanker Mary Ellen O'Neil



Link of main exhaust to waste heat boiler



One of the auxiliary generator sets

block of steel and is surmounted by a pressure chamber. The group of pumps on the MARY ELLEN O'NEIL is shown very plainly in one of the accompanying illustrations.

Fuel valves are opened by the action of the cams and are closed by the fuel pressure, the opening and timing being subject to the mechanical control of a cam and rocker gear. Between the fuel pumps and fuel valves there is on each cylinder a high pressure filtering device consisting of duplicate filters with a cut-off valve on each filter.

There are no scavenge valves because the scavenge air is admitted through ports in the cylinder.

As on the EAST INDIAN'S engines, however, a valve has been fitted to each cylinder of the new tanker's engines in connection with what is termed the engine brake. This device it is interesting to recall was just used on the CHALLENGER'S engine after that vessel was in commission and on account of its usefulness was later ordered for the EAST INDIAN'S engines. All that this engine brake accomplishes is to admit the compressed air from one cylinder near inner dead center to the adjoining cylinder with its corresponding near outward dead center. It is stated that when the order to reverse is received in the engine room the use of the engine brake, after the fuel has been cut off, enables the engines to be stopped much more quickly than is the usual practice, thus permitting a quicker reverse to be obtained.

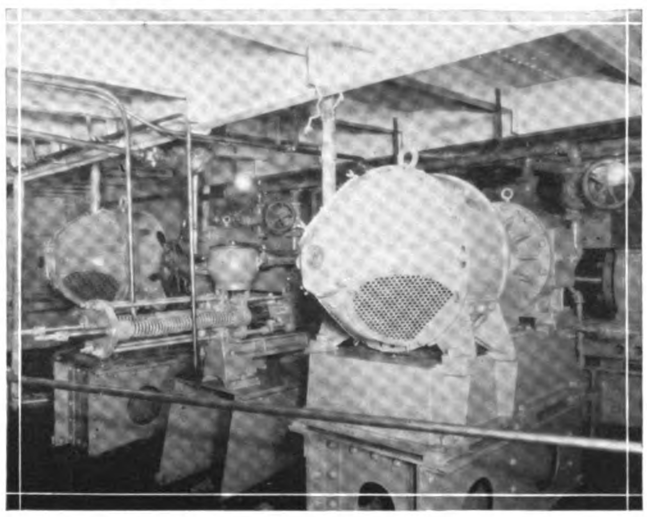
In Sun-Doxford engines scavenge air is admitted through the lower row of ports and sweeps upward through the cylinders, driving the exhaust gas out through the upper row of ports.

For lubrication of Sun-Doxford engines a forced feed system is used for the main bearings, crankpin bearings, crosshead guides and both the thrust blocks, the oil being supplied at a pressure of 30 lb. per sq. in. The oil in the lubricating system of each engine circulates through oil coolers before passing back to the pressure pump. A National Acme centrifuge is installed for the purpose of purifying the oil for each engine.

For cylinder lubrication Manzel "timed," force-feed oilers are used. These lubricators are arranged at the back of the engine at the level of the rear cam-shaft, from which they are driven by silent chains.

Near the control stand are arranged all the fuel and water connections, together with the gauges and controls.

Electrically driven maneuvering air compressor



Hydro-electric steering gear arrangement

Ms. Mary Ellen O'Neil's Auxiliary Machinery

Brief Description of Layout and Arrangement

SEATED on its own flat, aft of the two engines, is a Foster marine water tube boiler, having 4,000 sq. ft. of heating surface and four burners, fired by a Todd pumping, heating and fuel oil burning outfit. This boiler will be used for heating cargo in both the main and summer tanks, and to supply steam for the various units in the engine room, the main cargo pumps, and the steam deck machinery consisting of a windlass, two capstans and three winches. While under power at sea all engine room auxiliaries and steering gear are motor-driven, but in port, loading or discharging cargo, the steam pumps and steam electric light generator will be put in service. A Sturtevant forced draft blower furnishes the air for the cold, forced air draft system of the water tube boiler.

The main auxiliary units consist of 2 Worthington Diesel engines of 180 hp. each driving a 120 kw. Westinghouse D.C. generator. Two Worthington, three stage type air compressors, operated by 65 hp. Westinghouse motors with push button control at the operating platform, furnish air for the three main starting tanks. There is also an auxiliary air compressor, driven by a 5 hp. motor, for emergency purposes. Practically all motors and controls for engine room auxiliaries are Westinghouse make. There are two Worthington centrifugal fresh water pumps, either of which is capable of supplying the required needs of both main engines operating under full power. Only one motor is fitted between these pumps, and a clutch arrangement permits the use of either of the pumps—one acting as a stand-by while the other is running. The salt water pumping unit is identical with the fresh water outfit.

There are also two motor-driven Worthington centrifugal pumps—one for fire and bilge and the other for general service and fire use. It is worthy to note that all of the foregoing centrifugal pumps are driven by motors of the same power and speed; thus making one spare armature fit any of them if repairs should be necessary.

Two lubricating oil pumps, one fuel oil transfer pump, and one engine room bilge pump are all Worthington rotary type, having the same capacity and individual motors of the same size, again making it necessary to furnish only one armature as a spare for the entire group. Two rotary fresh water pumps take their suction from two large tanks, fitted in the 'tween decks, and discharge to the culinary fresh water line.

The lubricating oil used in the pressure system is cooled by two Griscom-Russell lubricating oil coolers, either of which has sufficient capacity to handle the cooling requirements for both engines. Fresh water, mentioned before as the cooling medium for the main engine jackets and pistons, is cooled by two Griscom-Russell jacket water coolers with by-pass arrangement to regulate the flow of water.

There are two Westinghouse motor-driven Watson-Stillman fuel oil starting pumps, capable of maintaining a pressure of 4,000 lbs. per sq. in. at the main engine fuel valves, with push button controls at the maneuvering platform of each engine. Two new type lubricating oil separators and two fuel oil separators—clarifier and purifier type—of National Acme make, furnished by W. B. Fletcher Company, Philadelphia, are fitted. These are driven by electrical motors and insure, at all times, a clean supply of both fuel and lubricating oil for the engines. They were fully described in our January issue.

The fuel oil supply system for this vessel functions as follows: The fuel oil transfer pump takes the fuel from the bunker and discharges it into a fuel settling tank containing heating coils, from which, after heating, it goes to the fuel oil separator, thence to the fuel oil purifier tank, and when the oil reaches a predetermined level in the tank, an automatic control starts a motor-driven pump which discharges the clean oil to a daily service tank from which it is piped to the main and auxiliary engines.

A 7-ton hand operated, single beam type crane, supported on rails at both sides of the engine room and running fore and aft over the entire length of both engines, affords a quick means for handling the big pieces on these engines. Beams fitted with travelers extend over the auxiliary engines and other large auxiliaries, so that all main and auxiliary units are within easy access of lifting gear.

The vessel is steered by an A. E. electro-hydraulic steering gear with a Hele-Shaw variable stroke reversible pump, operated from the pilot house by a telemotor. A hand steerer is fitted on the deck aft for emergency use.

The refrigerating set consists of a 2½-ton Brunswick ice machine operated by a Westinghouse motor direct connected to a compressor. A 40-gal. scuttle butt has been supplied in addition to the usual coils for the ice box and chill room.

The following steam auxiliaries have been supplied for port use: One 20 kw. Westinghouse, steam-driven, generating set; 1 auxiliary condenser mounted over a combined air and circulating pump; 1 feed water heater; 1 evaporator; 2 boiler feed pumps; 1 engine room bilge pump, 2 pump-room bilge pumps; 2 fuel oil transfer pumps; and 2 compound cargo oil pumps.

Equipment of Motortanker Mary Ellen O'Neil, Built and Engined by Sun Shipbuilding and Dry Dock Co., of Chester, Pa.

Propelling Machinery

Name of Unit	No.	Description and Characteristics
Main engine	2	Sun-Doxford, 2,100 hp., 4 cylinder, opposed piston, two-cycle, 21,259 in. dia. x 2 x 42.5 in. stk. x 82 r. p. m.
Propeller	2	Crain smelting, bronze bushings.
Crankshaft	2	Pin, 430 mm. dia.; shaft, 400 mm. dia.
Line shaft	2	13½ in. Erie Forge Co.
Propeller shaft	2	15 in. Erie Forge Co.
Thrust shaft	2	400 mm. Erie Forge Co.
Piston rings	—	American Hammered; 6 for each piston.

Boilers and Heaters

Donkey boiler	1	Water tube, 200 lb. working pressure, 4,000 sq. ft. heating surface. Foster.
Waste heat boiler	2	Exhaust gas fired, 125 lb. working pressure, 1,630 sq. ft. heating surface. Sun Sb. Co.
Feed water heater	1	20,000 gal. per hour. Griscom-Russell.
Fuel oil heating boiler	—	Todd.
Fuel oil burners	—	Todd.

Condensers and Coolers

Condenser	—	Horz. cyl. shell type, 1,200 sq. ft. cooling surface. Worthington.
Lubricating oil cooler	2	Each capable of cooling 200 g. p. m. from 100 deg. to 90 deg. Circulating water at 75 deg. Fahr. Griscom-Russell.
Fresh water cooler	2	Jacket type, each capable of cooling 300 g. p. m. of fresh water from 160 deg. to 120 deg The circulating water at 75 deg. Fahr. Griscom-Russell.
Evaporator	1	16 ton capacity in 24 hours.

Compressors

Main air compressor	2	3-stage, Worthington, connected to 65 hp. Westinghouse motors. Push button controls.
Auxiliary compressor	1	Driven by 5 hp. motor. Worthington compressor—Westinghouse motor.
Scavenge pump	2	Attached, double acting, 57½ in. dia. x 38.19 in. stroke. Sun Ship.

Pumps

F. o. injection pumps	2	Attached to main engines, 1,500 lb. pressure per sq. in. to 10,000 lb. pressure per sq. in. Sun Ship.
Lubricating oil pump	2	Rotary type, Worthington, driven by Westinghouse motors. 200 gal. per min. at 30 lb. per sq. in.
F. w. cooling pump	2	Rotary type, 50 gal. per min. at 50 lb. per sq. in. Worthington. Westinghouse motor driven.
F. w. circ. pump	2	Centrifugal type, 750 gal. per min. at 40 lb. per sq. in. Worthington. Westinghouse motor.
S. w. cooling pump	2	Centrifugal type, 750 gal. per min. at 40 lb. per sq. in. Worthington. One Westinghouse motor.
Fire and g. s. pump	1	Centrifugal type, 200 gal. per min. at 100 lb. per sq. in. Worthington. Westinghouse motor.
Fire, bilge, ballast and emergency s. w. pump	1	Centrifugal type, 200 gal. per min. at 100 lb. per sq. in. Worthington. Westinghouse motor.
Engine room bilge pump	1	Rotary type, 200 gal. per min. at 20 lb. per sq. in. Worthington. Westinghouse motor.
F. o. transfer pump	1	Rotary type, 200 gal. per min. at 30 lb. per sq. in. Worthington. Westinghouse motor.
Starting f. o. pump	2	Reciprocating type, 4,000 lb. per sq. in. at engine valves. Watson-Stillman. 2 hp. motor.
Lubricating oil pump	2	Rotary type, 200 gal. per min. at 30 lb. per sq. in.
Sanitary and ice machine pump	1	Centrifugal type, 200 gal. per min. at 50 lb. per sq. in. Worthington. 10 hp. Westinghouse motor.

Steam Pumps

Boiler feed pumps	2	10 in. x 7 in. x 24 in. v. s.—Worthington.
F. o. transfer pump	1	Horizontal duplex—6 in. x 5¾ in. x 6 in. Worthington.
Main cargo pump	2	12 in. x 20 in. x 13 in. x 24 in., 2,000 bbl. per hr. at 120 lb. per sq. in. Worthington.
Engine room bilge pump	1	Horizontal duplex, 7½ in. x 6 in. x 10 in. Worthington.
Pump room bilge pump	1	H. D. type, 7½ in. x 6 in. x 10 in. Worthington.
Pump room bilge pump	1	H. D. type, 6 in. x 5¾ in. x 6 in. Worthington.
Forward pump room F. o. transfer pump	1	H. D. type, 7½ in. x 6 in. x 10 in. Worthington.
Combined air and circ. pump	1	H. S. type, 12 in. x 14 in. x 14 in. x 12 in. Worthington.
Sanitary and ice mach. pump	1	H. D. type, 7½ in. x 6 in. x 10 in. Worthington.

Auxiliary Electrical Generators

Diesel generator sets	2	3-cylinder, 180 hp., airless injection Worthington Diesels connected to 120 kw. Westinghouse generators.
Steam driven generator set	1	20 kw., 240 v., Westinghouse generator.
Balancing set	1	60 amps., 240 v. to 115 v. Westinghouse.

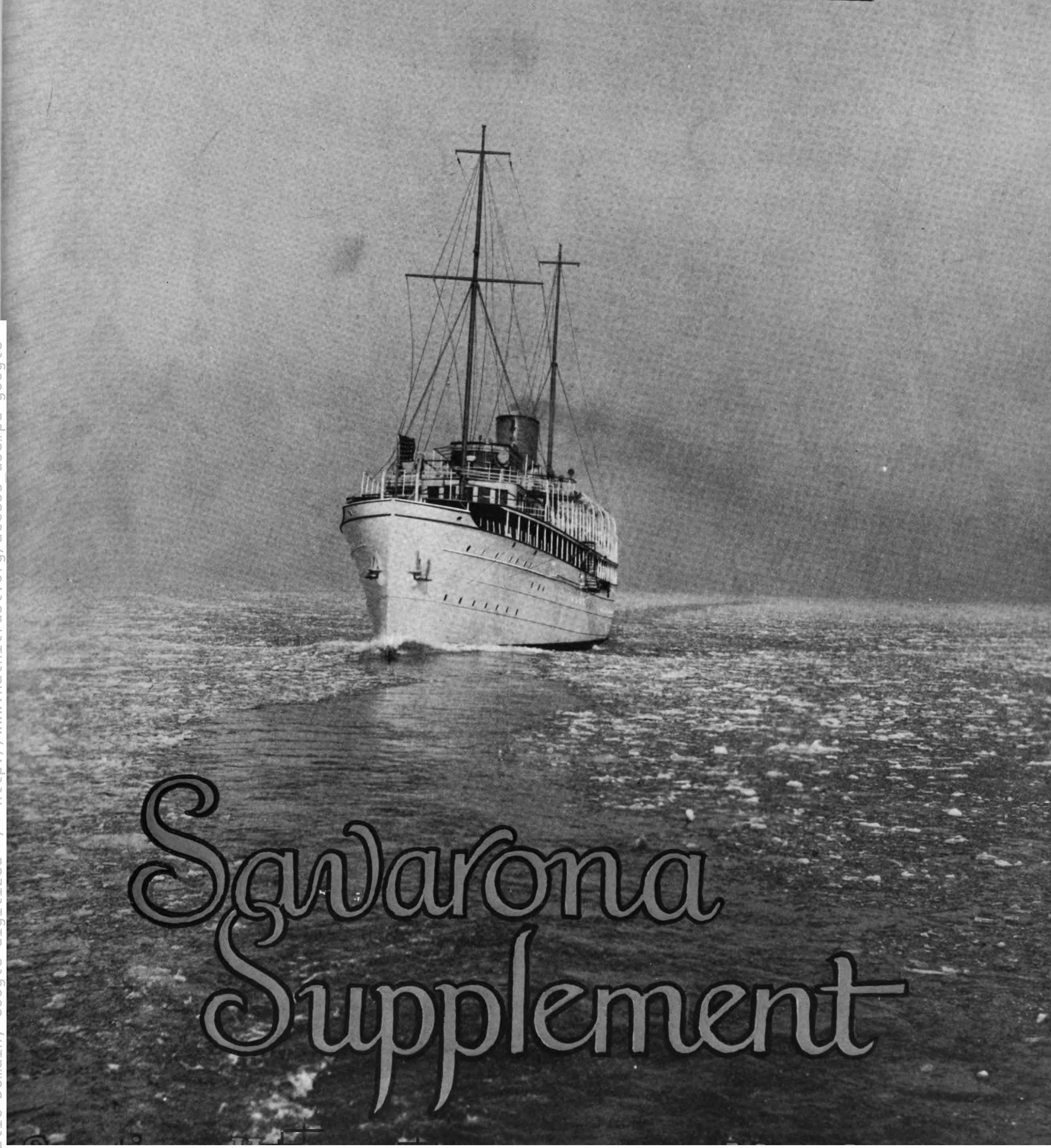
Tanks

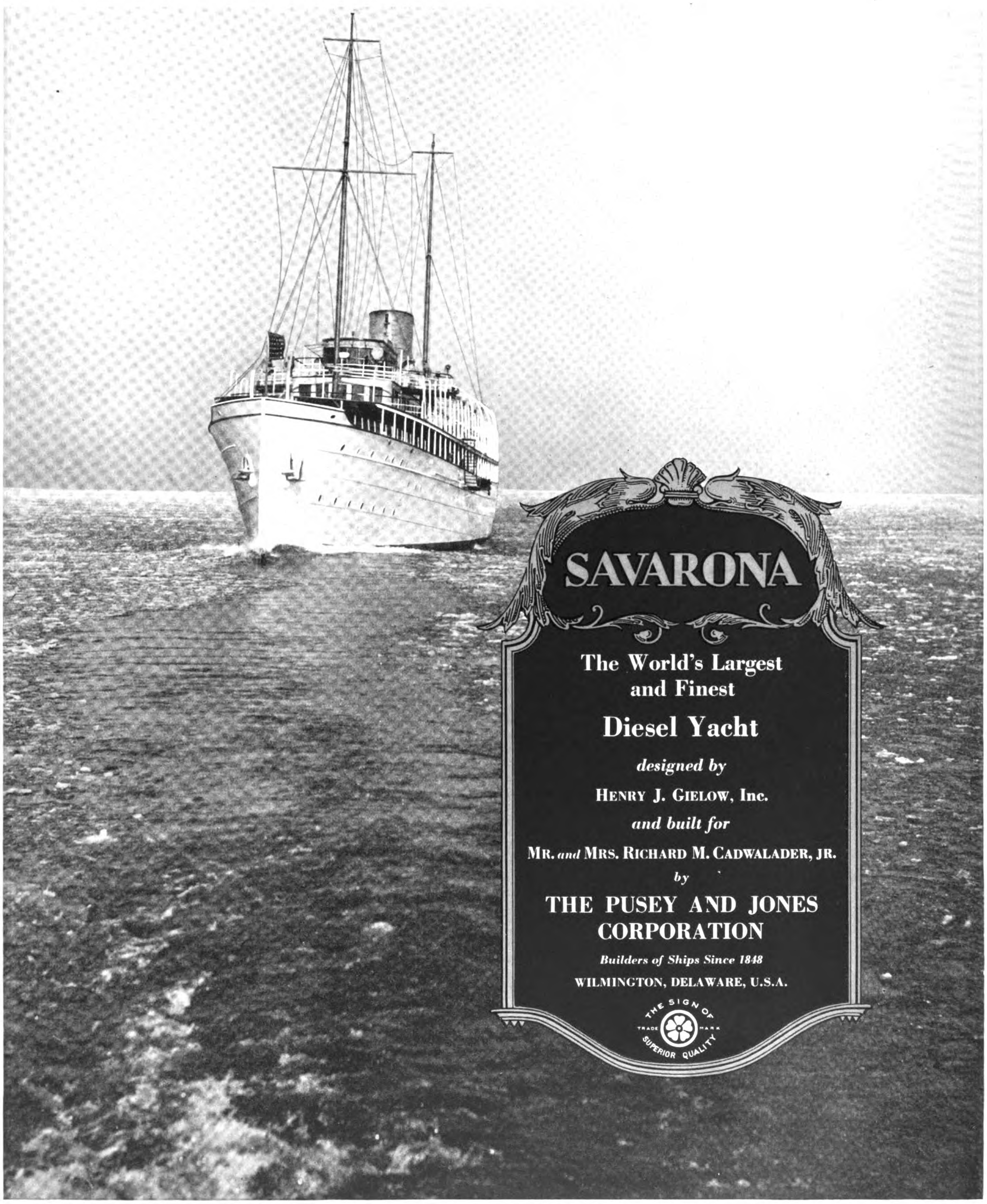
Cyl. lubricating oil tanks	2	Cyl. type, 600 gal. cap.
Crank case lubricating oil tank	7	Cyl. type, 600 gal. cap.
Main engine settling tanks	4	Cyl. type, each about 12 tons capacity.
Reserve circ. water tank	1	8 tons capacity.
Maneuvering air tanks	3	Each having a capacity of 150 cu. ft. at 600 lb. per sq. in. pressure.
Maneuvering air tank for auxiliary eng	1	Having a capacity of 30 cu. ft.

Miscellaneous

Steering gear	1	American Engineering hydro-electric, Hele-Shaw reversible pump. Controlled from pilot house by telemotor.
Refrigerating machinery	1	2½ ton Brunswick-Kroeschell ice machine operating by Westinghouse motor.
Radio compass	1	
F. o. separator	2	National Acme—motor driven.
Lubricating oil separator	2	National Acme—motor driven.
Main engine lubricators	—	Manzell.
Pneumercators	—	Parks.
Indicators and agitators	—	McNab.
Main engine silencer	—	Sun Ship.
Auxiliary engine silencer	—	Worthington.
Circ. water strainer	—	Andale.
Piston cooling f. w. strainer	—	Andale.
Engine room crane	—	Maris Bros.
Blowers	—	Sturtevant.
Valves up to 2 ins	—	Powell.
Hull rivets	—	Champion.
Enamels and paints	—	Hildreth Varnish Co.
Wire rigging rope	—	John A. Roebling Sons.
Thermometers	—	Precision.
Galley	—	Webb.
Exhaust pipe lagging	—	Phila. Asbestos Co.

Motorship



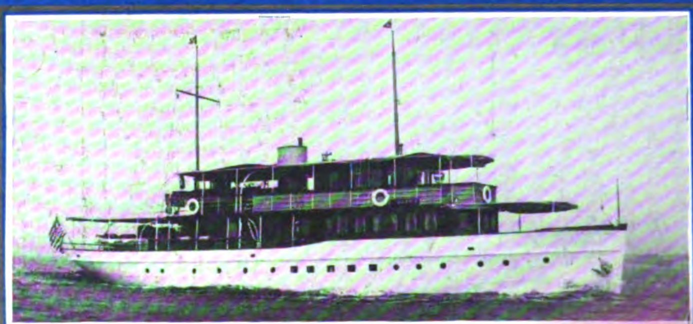

SAVARONA
The World's Largest and Finest
Diesel Yacht
designed by
HENRY J. GIELOW, Inc.
and built for
MR. and MRS. RICHARD M. CADWALADER, JR.
by
THE PUSEY AND JONES CORPORATION
Builders of Ships Since 1848
WILMINGTON, DELAWARE, U.S.A.
THE SIGN OF SUPERIOR QUALITY
TRADE MARK

"VIDOR", 171′ x 27′ 4″ x 13′, Mr. Carll Tucker, *owner*

DIESEL YACHTS *designed by* HENRY J. GIELOW, *Inc.* *and in Commission*

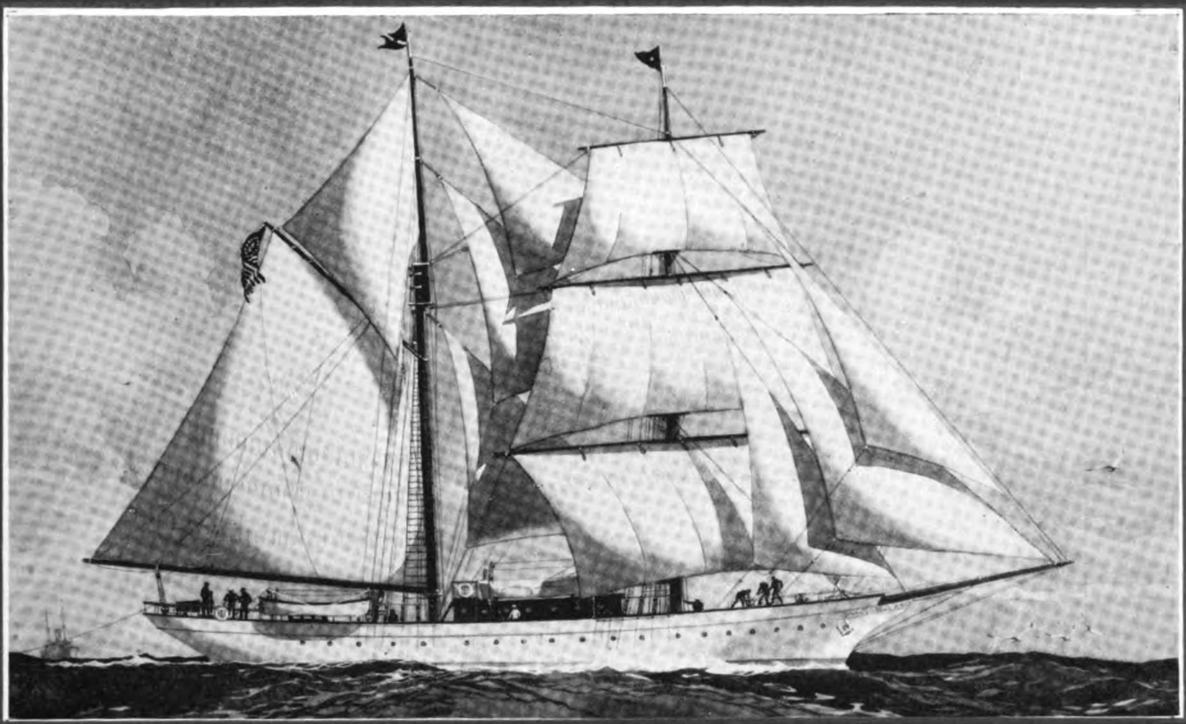
"SHIRLOHN", 110′ x 19′ 6″ x 6′, Mr. G. M. Williams, *owner*

"CAROLINE", 171′ x 27′ 4″ x 13′, Mr. E. R. Johnson, *owner*



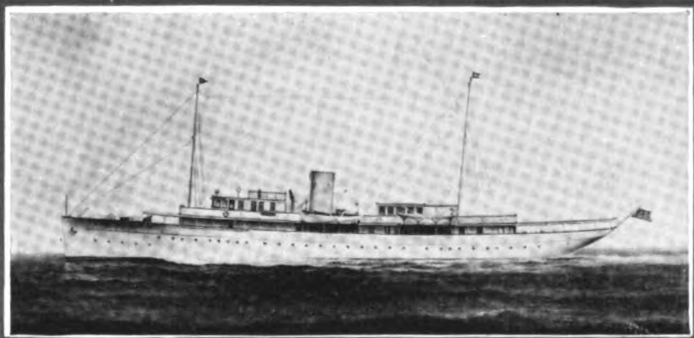
"ALPHA", 100′ x 20′ x 4′ 6″, Mr. L. S. DeGraff, *owner*

"SUMAR", 160′ x 20′ 1″ x 12′ 6″, Mr. David C. Whitney, *owner*



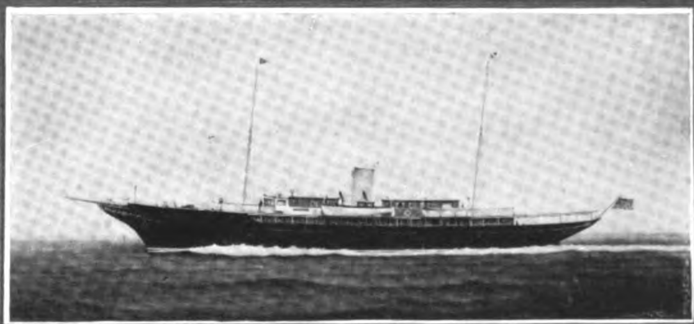
"ILLYRIA", 147′ x 30′ x 12′ 6″, Mr. Cornelius Crane, *owner*

"SEA SAILS III", 87′ x 16′ 9″ x 4′ 6″, Mr. Murray W. Sales, *owner*



"ARA", 240′ x 36′ 4″ x 14′ 6″, Mr. Ernest B. Dane, *owner*

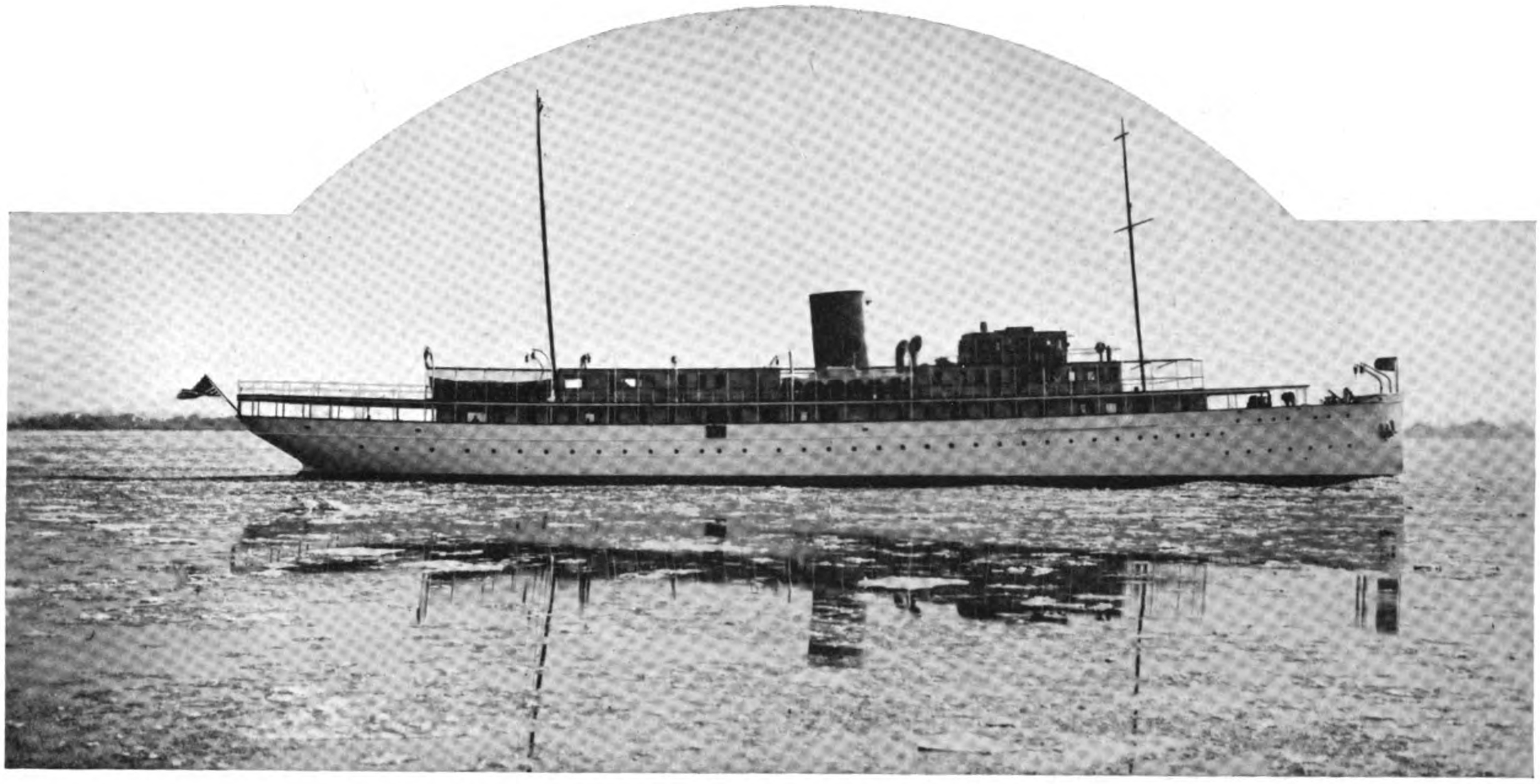
"SACHEM", 115′ x 21′ x 7′ 6″, Mr. George Whitney, *owner*



"CAMARGO", 225′ x 32′ 4″ x 14′ 6″, Mr. Julius Fleischmann, *owner*

Experience

HENRY J. GIELOW Inc.
are likewise Specialists in the Design of Commercial Craft and in the Conversion of Steamships to Motorships



A Constructional Milestone

The Motoryacht *Savarona*—World's Largest and Most Luxurious—Marks a Step in the Technique of Ship Building

By A. C. HARDY, B.Sc., F.R.G.S., A.M. Inst. N. A.

Member of the Society of Naval Architects & Marine Engineers, New York
Author of "American Ship Types," "Motorships," "Motorshipping," "Seaways and Sea Trade," "From Slip to Sea," etc. Editor of "Motorship."

IT is a long cry from the first power-driven yacht ever built, the 230-ton, 110 h.p. side-lever-engined *Menai,* of 1830 to the palatial *Savarona* of 3,000 h.p. and 294 ft. in length, completed in March, 1928. But when we realize that the *Menai,* small though she was, cost just $100,000, and the *Savarona* cost just $2,-000,000, we are right in assuming that the yacht-building industry is one which calls for the highest and best in designer skill, in equipment, in workmanship and in finish. If yachting is essentially the pursuit of the wealthy, then in the space of 98 years which have elapsed since the *Menai* was commissioned, wealth has at least contributed something towards the science of ship construction.

For yacht building and designing is no ordinary job of naval architecture. In a plain cargo boat you know that the ship has to carry so many tons of cargo at a certain speed and at a certain draft of water. A passenger carrier has broadly the same conditions to meet except that the freight, being in part human, has to be given a degree of comfort which is not necessary in the case of mere "freight." The yacht, on the other hand, is subject to the whim of one owner who wishes to lavish on his ship all the amenities of life ashore; who wishes to take his large and luxurious home to sea with him; who wishes all the glamour of sea travel with none of its discomforts.

To satisfy these conditions, the architect has to collaborate very closely with the artist, the interior decorator, and the expert in culinary art. At the same time he has to satisfy all these conditions within a seaworthy hull and, in the majority of cases today, this hull has to have the power and cruising ability to go round the world if necessary.

Never was a greater array of devices, designs, and developments available for these requirements than at the present day.

Power yachting has always followed and occasionally preceded developments in power shipping, and the story of yacht powering from its inception in 1830 to the present day is largely one which links up the outstanding developments in marine engineering. When the high speed steam reciprocating engine was at its zenith, one finds that there were its representatives among the yachts with craft like the well-known *Iolanda* of 305 ft. in length and 4,000 h.p. The turbine

(*Please turn to page eight*)

era, too, found ships like W. P. Rouss' *Winchester,* designed on the lines of a torpedo boat destroyer which, only 165 ft. in length and displacing but 180 tons, had Parsons turbines and Yarrow boilers which gave her 26¾ knots on the Skelmorlie mile.

So, too, in the motorshipping era, we find ships like the *Savarona,* wonder yacht of the world, and pride of the American yacht fleet. America has always been the sponsor of the power yacht and has a larger number of power yachts than any other nation. Her luxury yachts are as numerous as they are always up-to-date.

From its establishment as a definitely reliable and economical medium of ship propulsion, the Diesel engine has had naturally a special attraction for American yachtsmen. So much so that steam-driven yachts today are practically negligible.

This is understandable. The Diesel yacht is always clean. It is always a cool ship, and the yachtsman generally likes tropical waters. It is economical to operate—a point which appeals even to the wealthy. It has a radius of operation without bunkering, which could never be realized in one's wildest dreams with a steam yacht.

Dirt, heat, bunkering delays eliminated; more space for rooms; plenty of electrical power for such steadying devices as gyro stabilizers and for such navigational refinements as gyro compasses, and "metal mikes"—and even for pipe organs . . . that is the modern motoryacht.

That, in a word, is this super-yacht *Savarona,* which a combination of the skill of Henry J. Gielow, Inc.—who designed her—Pusey & Jones, of Wilmington—who built her—and the Bessemer Gas Engine Co.—who powered her—has made possible. Mr. Richard M. Cadwalader, Jr., of Philadelphia, is helping to make motorshipping history wherever he takes his new ship.

Savarona, incidentally the second ship to bear this name, has been built for extensive ocean cruising and with a view, I am informed, to being Mr. Cadwalader's floating home. Nothing has been left undone to meet these exacting requirements.

In order to go on long cruises, the ship is equipped with large fuel oil storage tanks of over 350 tons capacity, giving a cruising radius at 15 knots, of 11,000 nautical miles. Moreover, two hundred and thirty tons of fresh water are carried and a 3½-ton distiller is provided in addition. There is space for four thousand gallons of lubricating oil and for 1,000 gallons of gasoline for the ship's launches.

Consideration of comfort being paramount, the yacht can be heated to 75 deg. Fahr. in zero weather and cooled and ventilated in hot weather, while for extra heating there are provided electric heaters in each stateroom and bathroom; every room has electric fans.

The hull, whose fine lines are well shown in the drawings and pictures, is designed to have the finest seagoing qualities, an easy, long period of rolling and pitching, high freeboard and good flare at bow and a short overhang at the stern. Her good qualities were showing in the 60-mile gale which the yacht came through in a splendid manner on her trial trip from Wilmington, Del., to New York.

The hull and machinery are built to class 100 A-1 Lloyd's and are strengthened and webbed in excess of the requirements. This has produced a strong, rigid hull, free from vibration at all speeds.

The owner's and guests' quarters are very large; the living-room and drawing-room each are 26 ft. square, lighted by large observation windows. The owner's private quarters consist of a sitting-room, stateroom, two bathrooms, a dressing-room and a maid's room, are all on the main deck. The guests' quarters on the cabin deck comprise seven double staterooms and one single stateroom, each with its own private bathroom. At the forward end of the upper deck is an observation room 18 ft. square with an unobstructed view.

At the after end of the upper deck is a lounge finished in teak, opening out into the deck shelter and after-deck.

A novel feature is the large pipe organ installed in the forward end of the after-deck house with tone openings into the living-room and main lobby and with the console in the upper main lobby.

The yacht is equipped with a Sperry Gyroscope which entirely eliminated the rolling even during the heavy storm of the trial trip. A maximum roll of 12 degrees each side was reduced to zero.

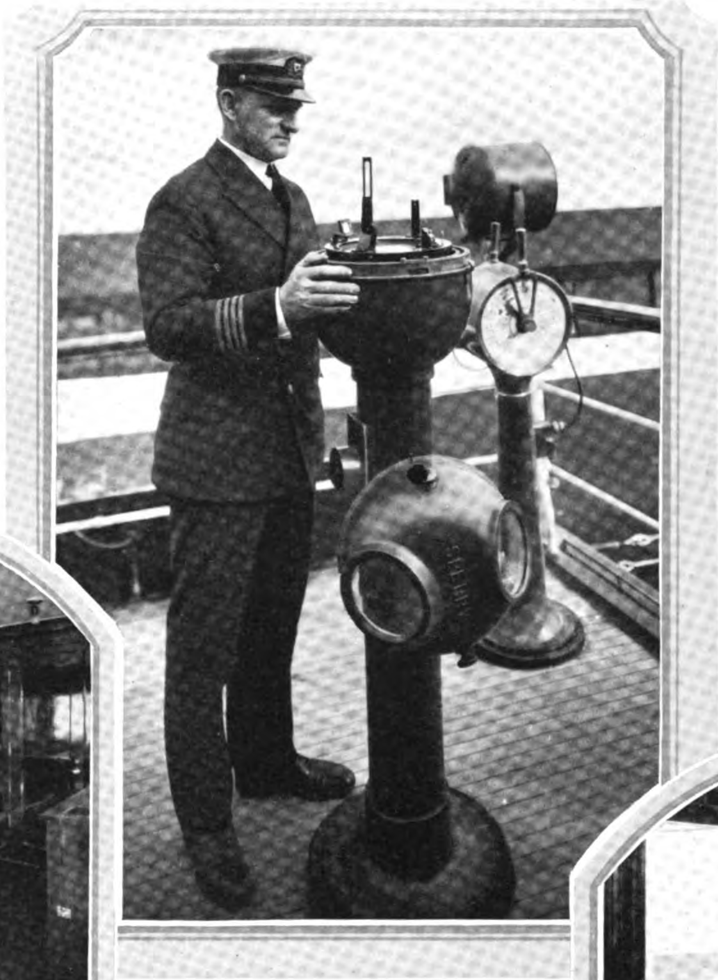
The yacht is completely equipped with life saving apparatus, fire extinguishers, two 28-ft. lifeboats (one motorized). The owner has a 30-ft. launch and a 26-ft. high-speed boat and the crew has a 26-ft. crew's launch.

The owner has, on the main deck, a covered deck 50 ft. by 35 ft. and at the stern, on the upper deck, covered by an awning, a clear space 240 ft. long. The space between the rail and deck houses is 10 ft. wide and ten times around this deck equals a mile.

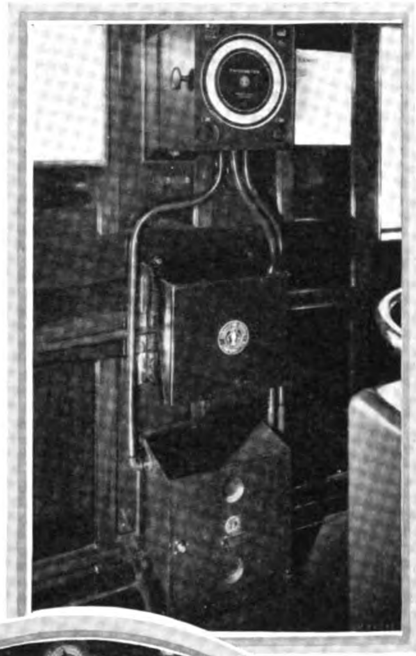
As the drawings show, there is a remarkably roomy and well arranged machinery space layout. The main power plant consists of two 8-cylinder 1,500 b.h.p. Bessemer airless injection Diesels of special design, with Tifoco crankshafts, direct connected to the propellers. These engines are of 18-in. bore by 22-in. stroke and develop their full-rated power at 300 r.p.m. The thrusts are incorporated in the engine base. All of the engine pumps, except the fuel pumps, are independently motor driven and each is of capacity to run both engines at full power. With her 3,000 h.p., *Savarona* is one of the most powerful yachts in the world. The duplicate De Laval water circulating pumps are of 300 gallons per minute capacity at 40 lbs. per square inch and are piped so that either can serve each engine, the fire-fighting system and, through the manifold, the bilge system.

The main engines are connected to their respective propellers through the medium of the usual thrust, line, and tail shafts. The drawing on page 10 of this Supplement shows how the shafting is carried along aft out through some particularly fine bossing work to the propellers. I made a particularly thorough inspection of the ship in way of the shafting because, as you will see from the drawing, there are lots of fresh water and trim tanks around in this part of the ship, which also is fine lined, a special feature having been made of the hull form by the Gielow designers. Great ingenuity has been displayed in arranging complete accessibility to all bearings and shaft couplings.

(Please turn to page ten)

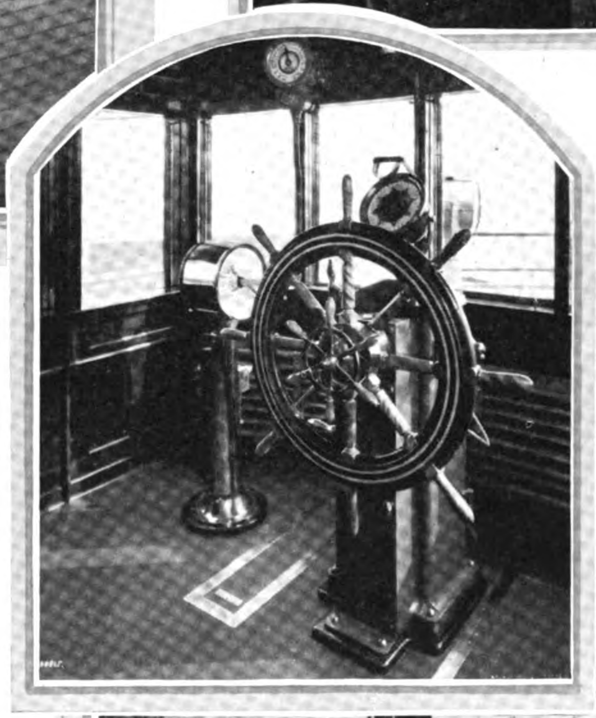


The Fathometer aboard the Savarona, an instrument which displaces the time-honored lead



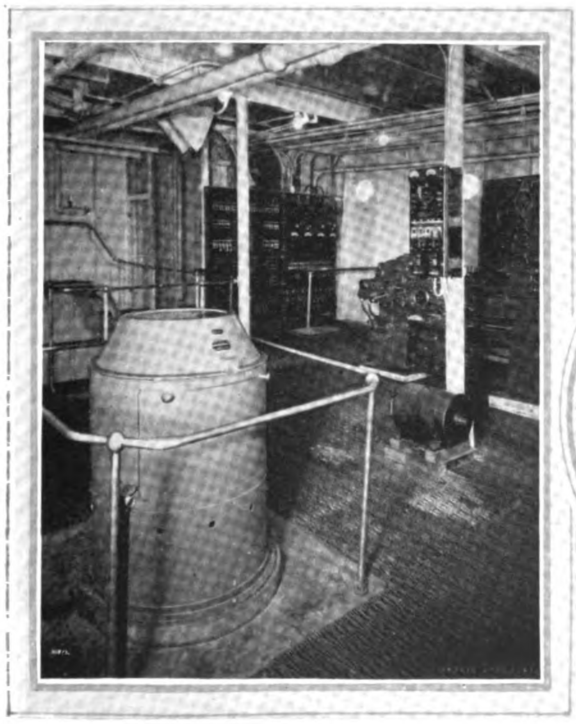
The Kolster Radio Compass, an instrument which makes navigation simpler

Savarona's Captain taking an azimuth bearing with a Sperry Gyrorepeater

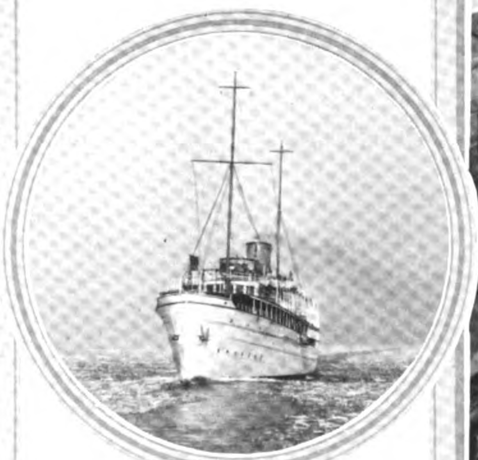


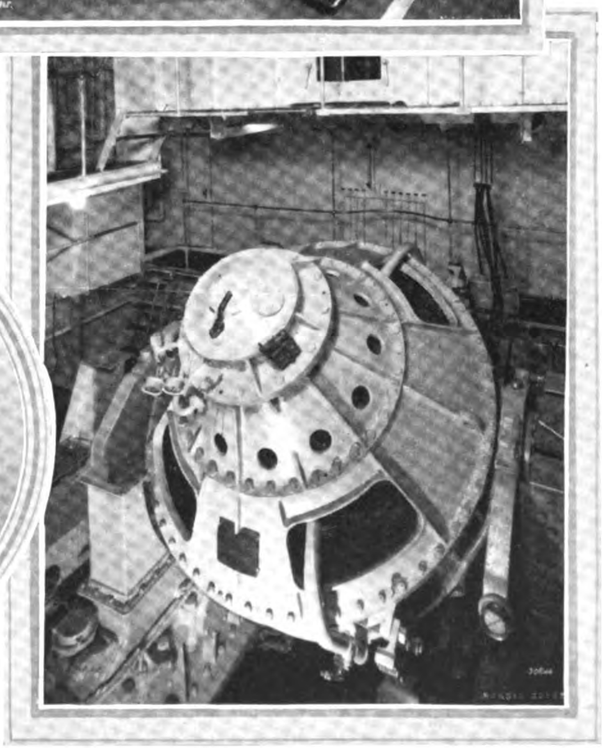
To the right is illustrated the Sperry special automatic and hand control steering unit

The Sperry Master Compass mounted on the main engine room platform



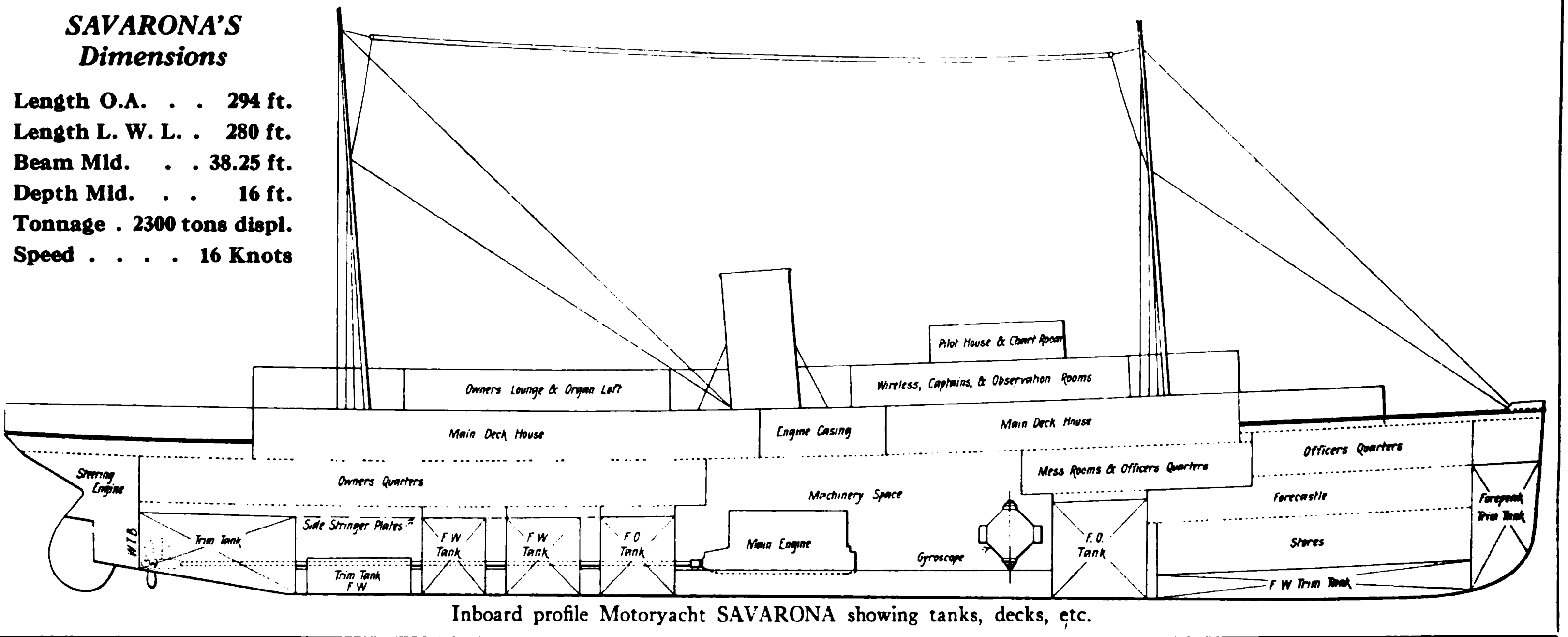
To the right is the Sperry Gyroscopic Stabilizer, a real necessity on a yacht





SAVARONA'S Dimensions

Length O.A. . . .	294 ft.
Length L. W. L. .	280 ft.
Beam Mld. . .	38.25 ft.
Depth Mld. . .	16 ft.
Tonnage .	2300 tons displ.
Speed	16 Knots



Inboard profile Motoryacht SAVARONA showing tanks, decks, etc.

The propellers themselves are attached to their tail shafts at the outboard ends of sturdy "A" frames reminiscent of those fitted to torpedo boat destroyers. Goodrich cutless rubber strut bearings have been used in order to secure complete immunity from shaft scoring and vibration, unpleasant to owner and guests, in any and all sorts of water, and with all sorts of matter in suspension—the sand of the shallow North Sea or the heavy mud of some of the Indian rivers.

The duplicate lubricating oil pumps are of the Northern Fire Apparatus Co. type, 175 gal. per min. at 35 lbs. per sq. in. pressure. These take the oil from the sump tanks, forcing it through the strainers and coolers to the lubricating oil system and the engines. They are piped to transfer the storage oil as required.

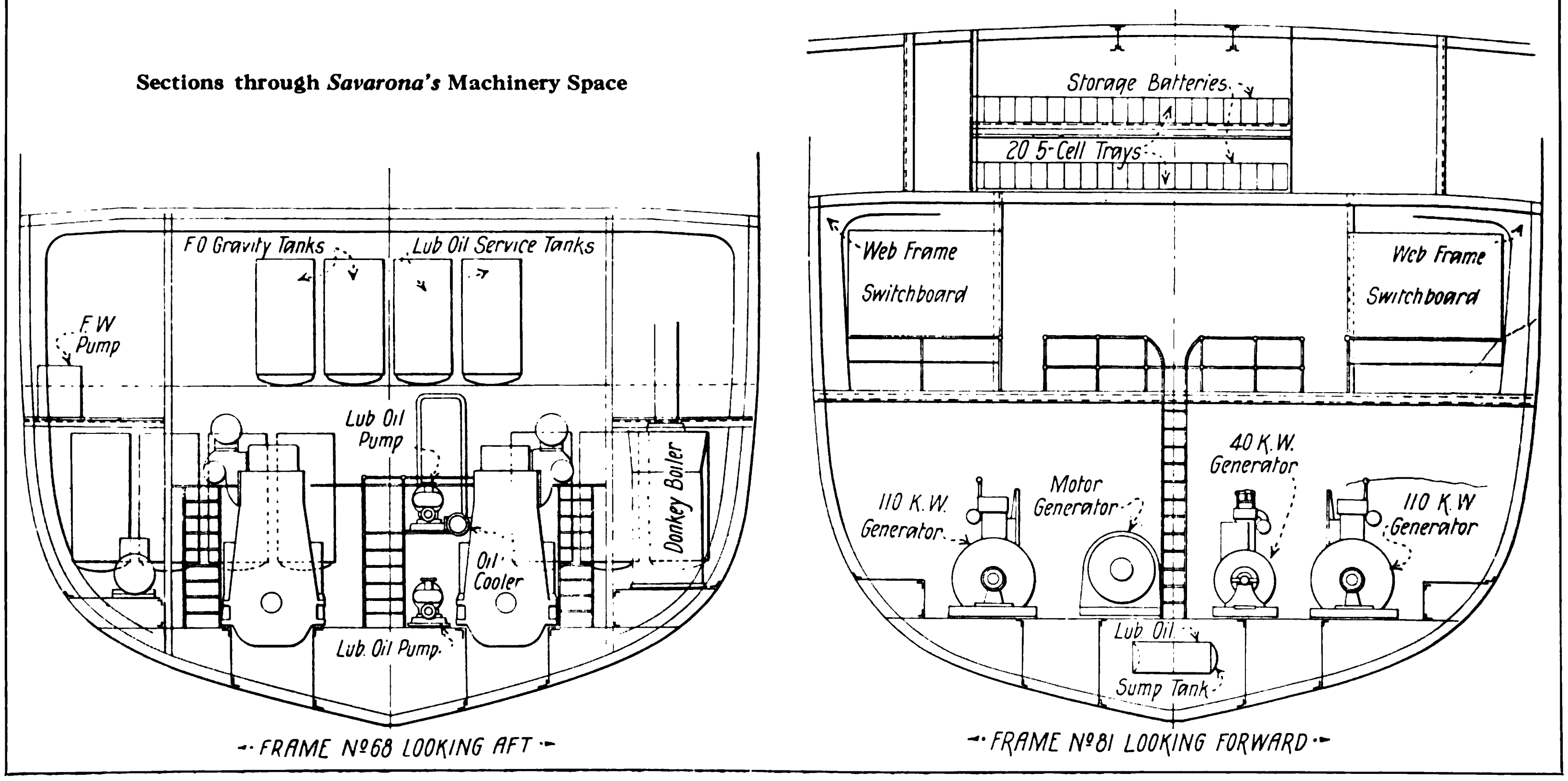
The coolers are placed at the back of the engine, giving the minimum run of piping and providing complete accessibility for cleaning or repairs. Each cooler has capacity to handle the lubricating oil cooling of both engines with sea water at 95 deg. Fahr.

The fuel oil transfer pump, a Northern 60 g.p.m. unit, is piped to each of the 15 main fuel oil storage tanks built into the ship, the separators, the daily service tanks and can transfer from each tank to any other tank.

The lubricating oil transfer pump, a Northern, 30 g.p.m. unit, is piped to draw from all storage tanks, sumps and deliver to daily service tanks, separators and storage tanks.

The compressors are of Ingersoll-Rand make, motor driven, of 26 cu. ft. per minute capacity at 350 lbs. per sq. in. These deliver to the main air line header which

Sections through *Savarona's* Machinery Space



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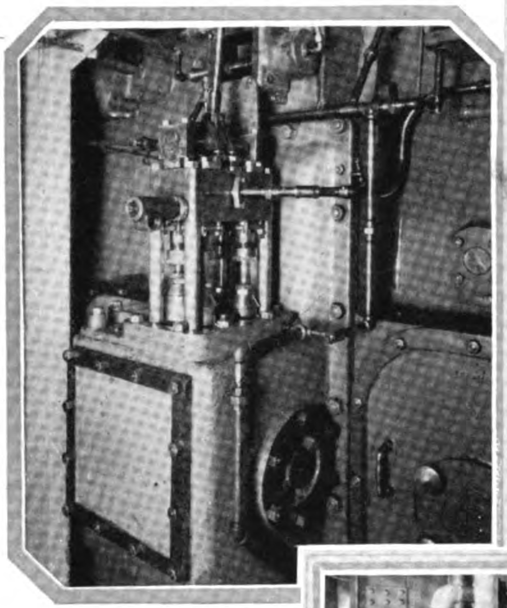
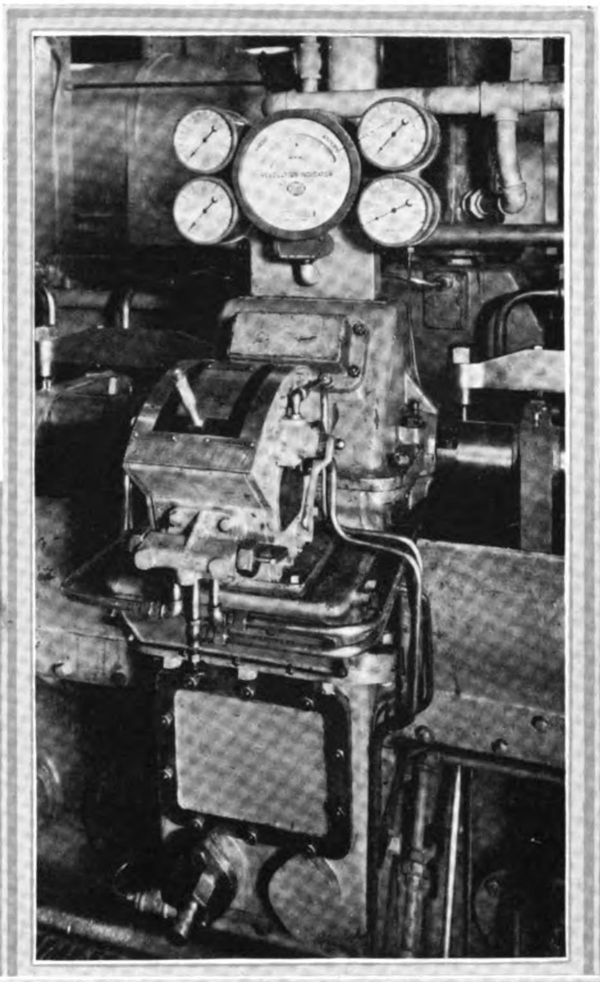
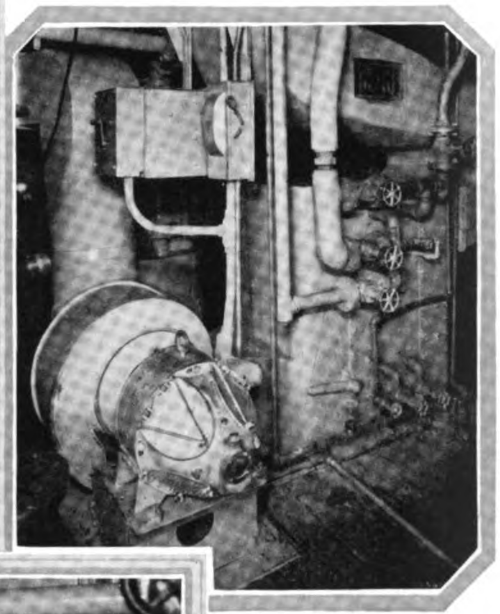
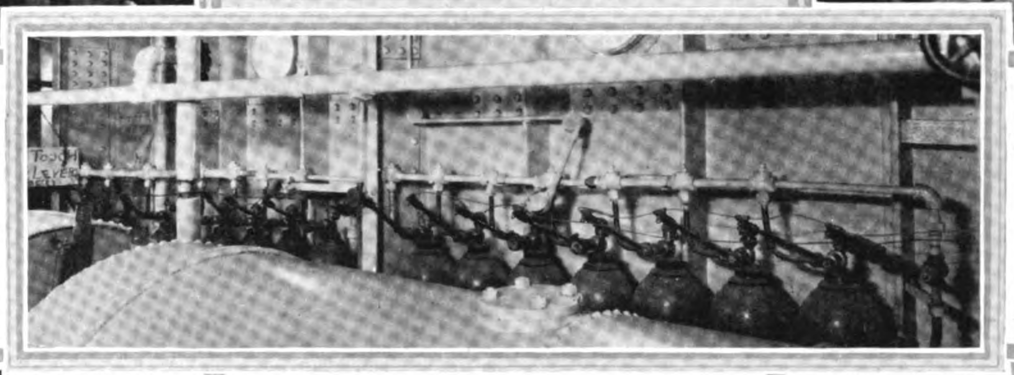
The fuel pump on the big 1500 h.p. Bessemers

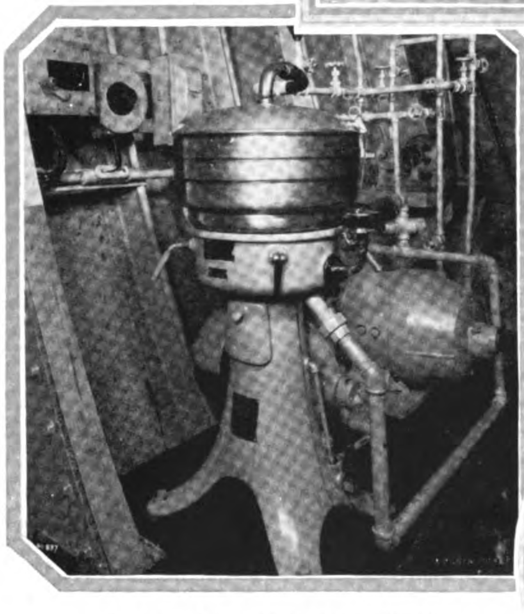




The Thermofan heating and cooling control mechanism





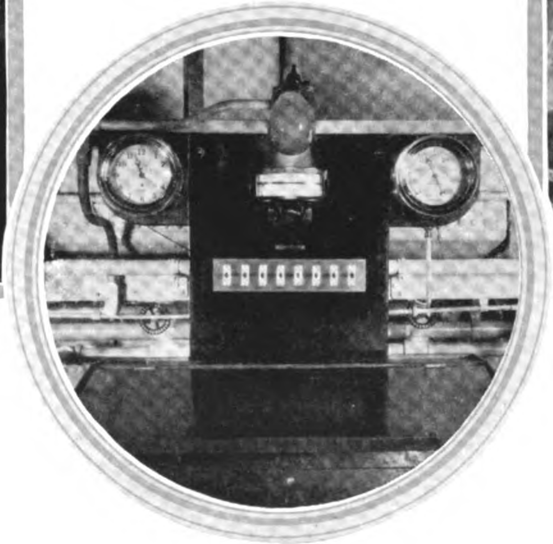


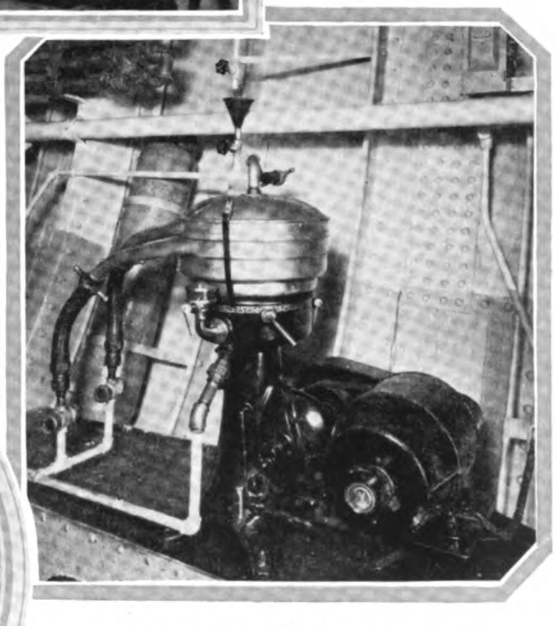
DeLaval Gas-Tight Centrifugal Lubricating Oil Purifier

At top—the control station of one main engine

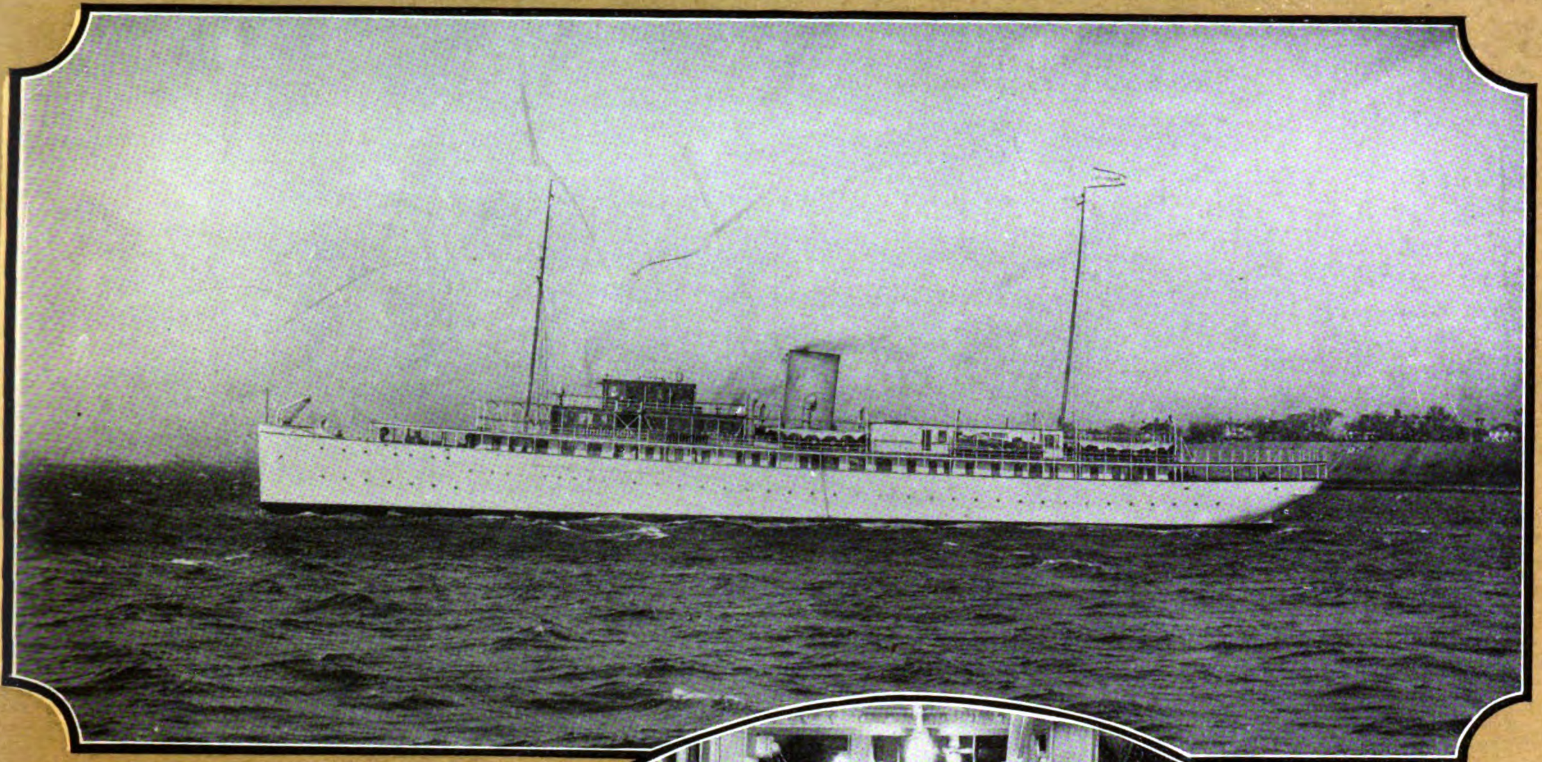
Underneath—installation of Lux Co_2 tanks used for fire protection

Hereunder—the Brown Pyrometer for measuring exhaust gas temperatures on main engines

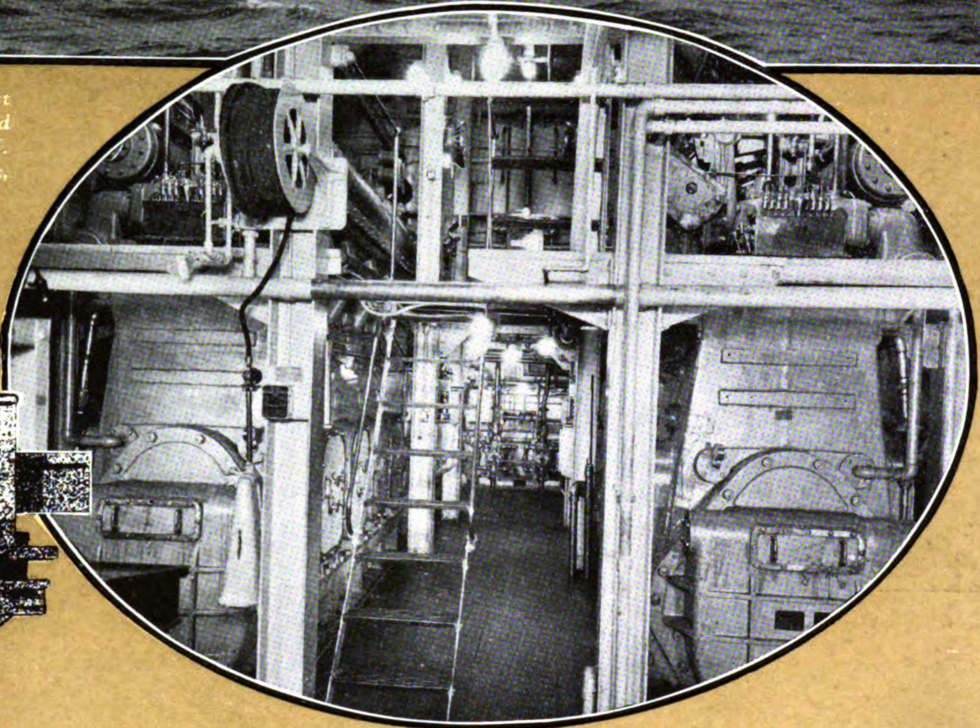




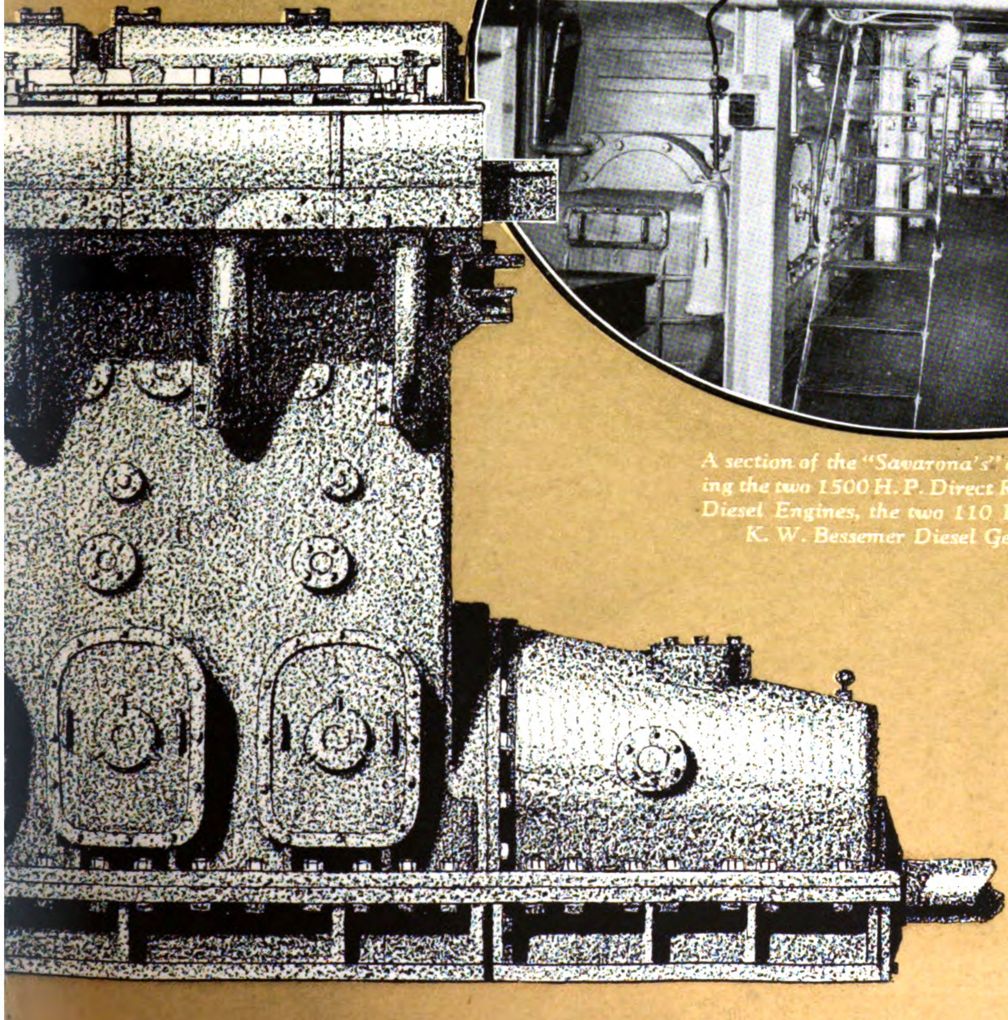
DeLaval Gas-Tight Centrifugal Fuel Oil Purifier



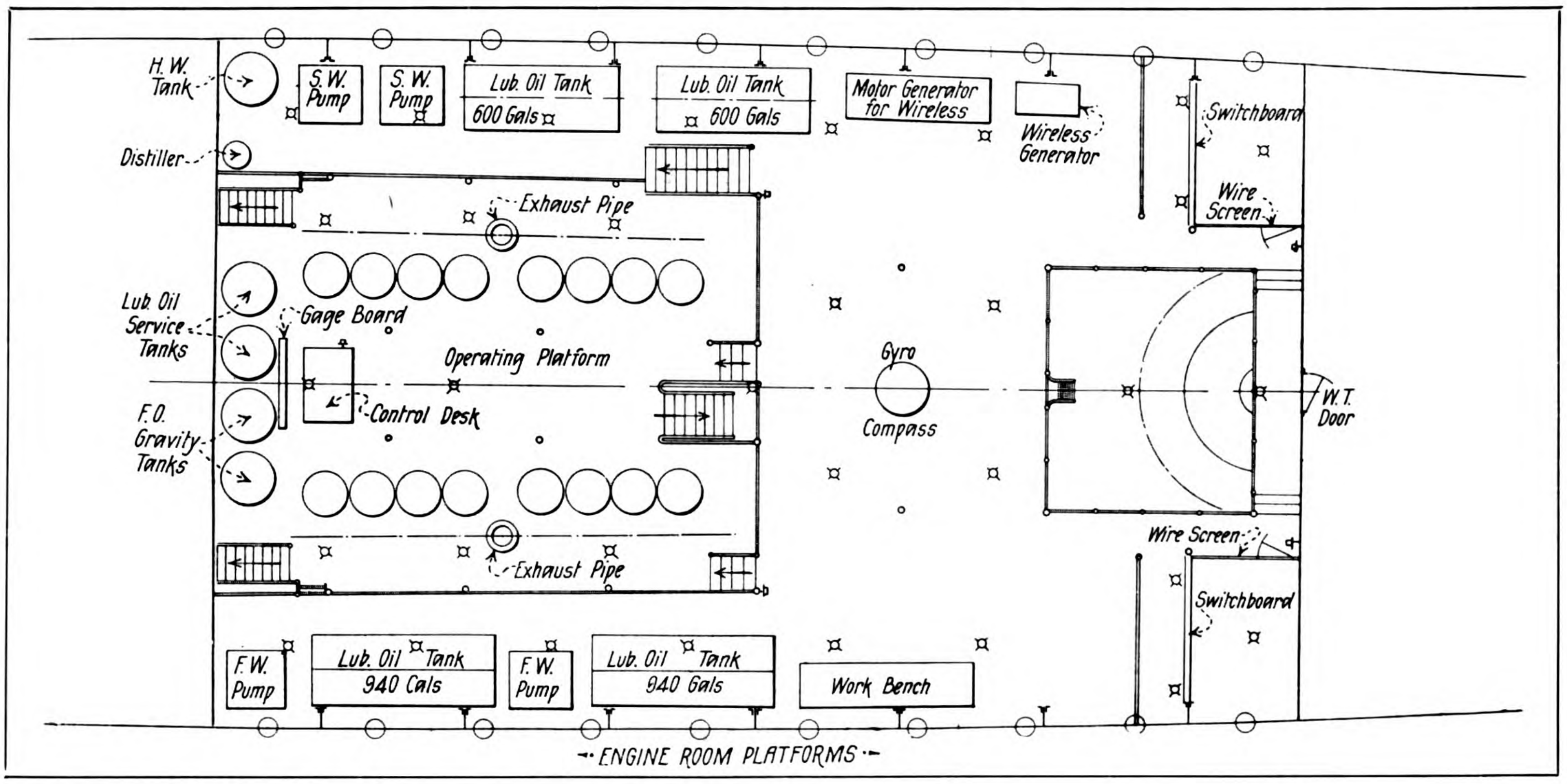
The "Savarona," world's largest Diesel yacht. Owned by Mr. Richard Cadwalader, designed by Henry J. Gielow, Inc., built by Pusey & Jones, powered by Bessemer.



A section of the "Savarona's" engine room, showing the two 1500 H. P. Direct Reversible Bessemer Diesel Engines, the two 110 K. W. and one 40 K. W. Bessemer Diesel Generating Sets.



MARINE ENGINES



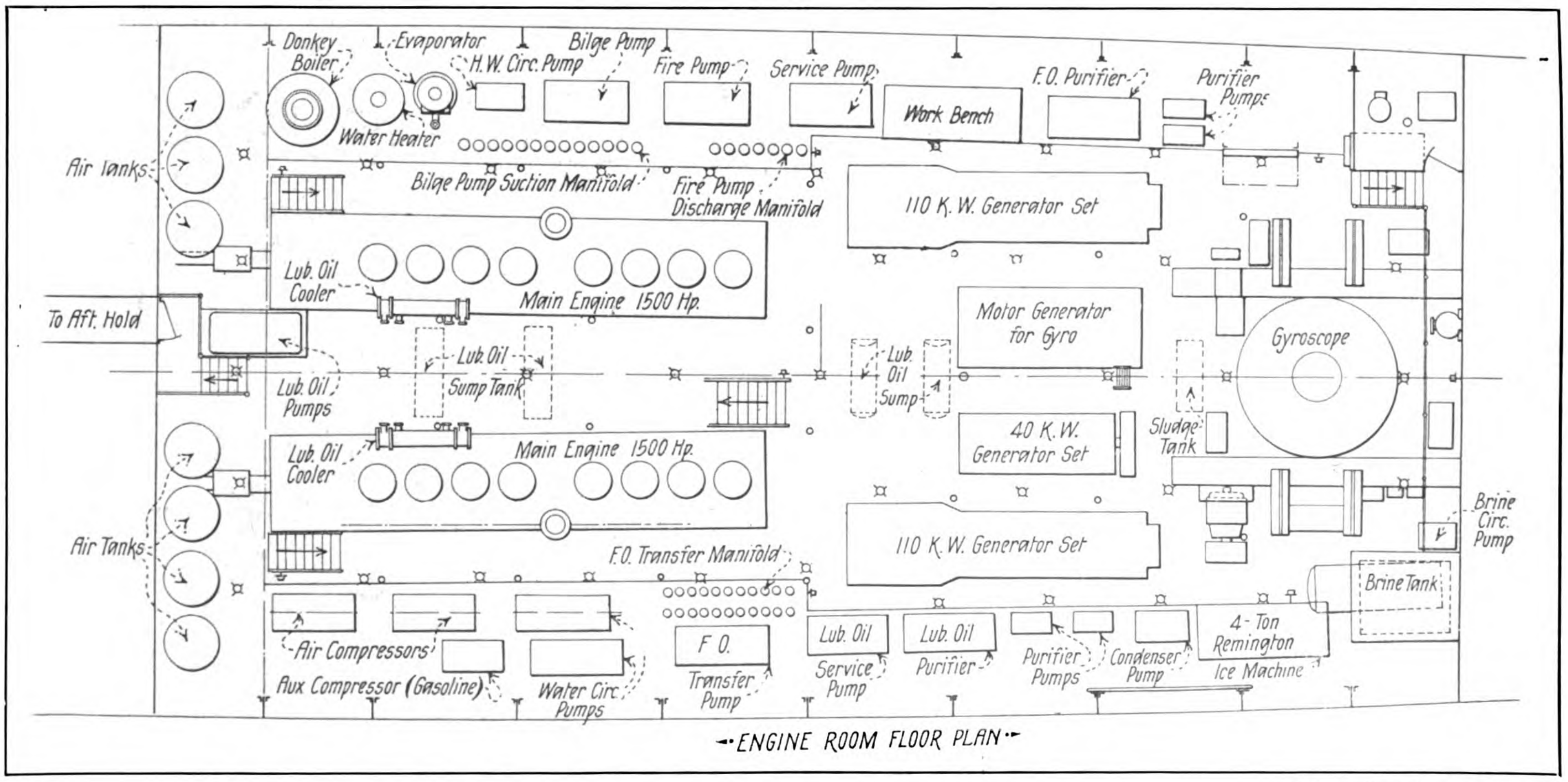
stores air in the seven air tanks and one whistle tank, each 36 in. dia. by 84 in. long. These tanks are also supplied with air from the compressors on the auxiliary generating sets.

The separators, one for fuel and one for lubricating oil, are the De Laval make, and are served by two Viking motor-driven pumps drawing oil from the sumps and storage tanks and delivering to daily service and clean oil storage tanks.

The bilge, fire and service pumps are motor driven, Northern make, each of 100 g.p.m. type at 60 lbs. per sq. in. working pressure and all cross connected to bilge manifold and all serving engines, oil coolers and fire system and the gyroscope oil coolers.

The yacht can be fire protected by the above pumps throwing a total of 1,000 g.p.m. at 40 lb. per sq. in. pressure through hose connections, distributed all over the boat. There is also the well-known Lux CO_2 system with connections from the storage tanks to the engine room, galley, under engine room floor plates, paint locker and hose reels in the upper engine room. This system can be operated from the main deck or in the engine room.

Savarona is heated, cooled, ventilated and humidi-



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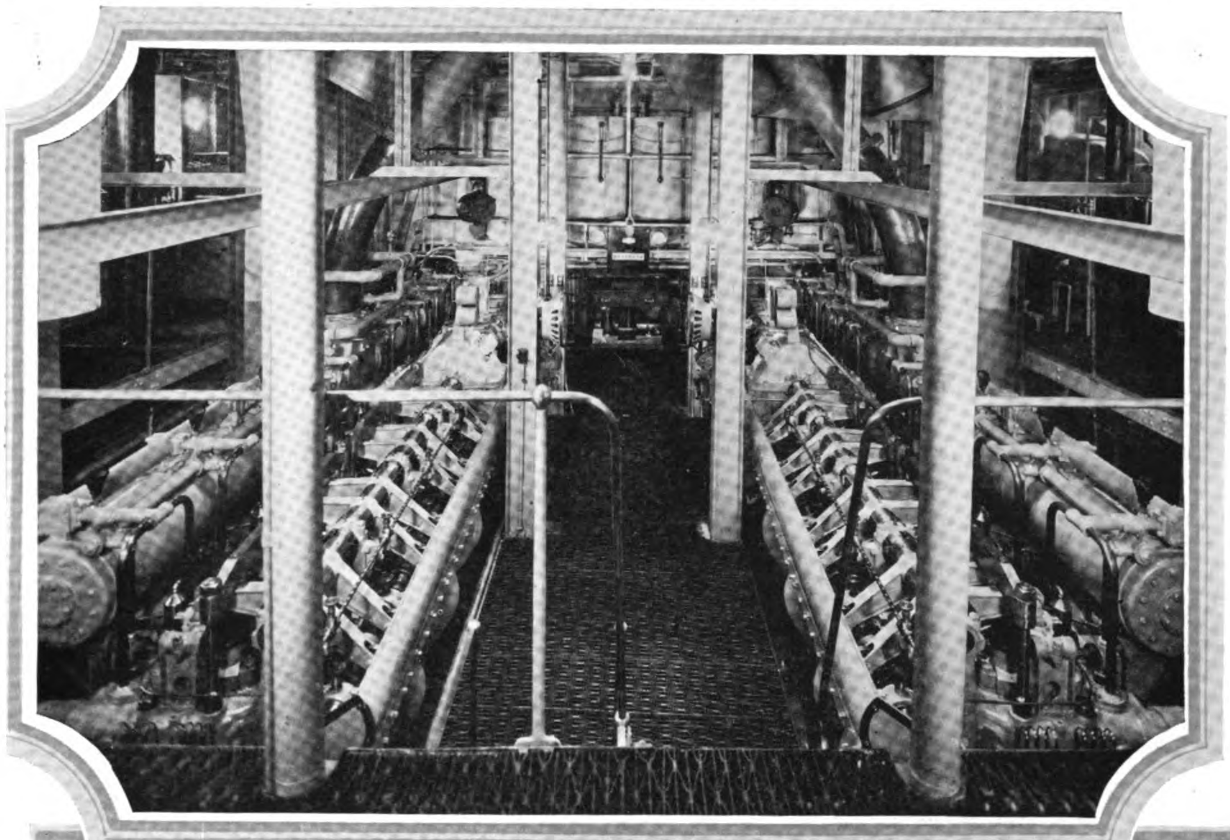
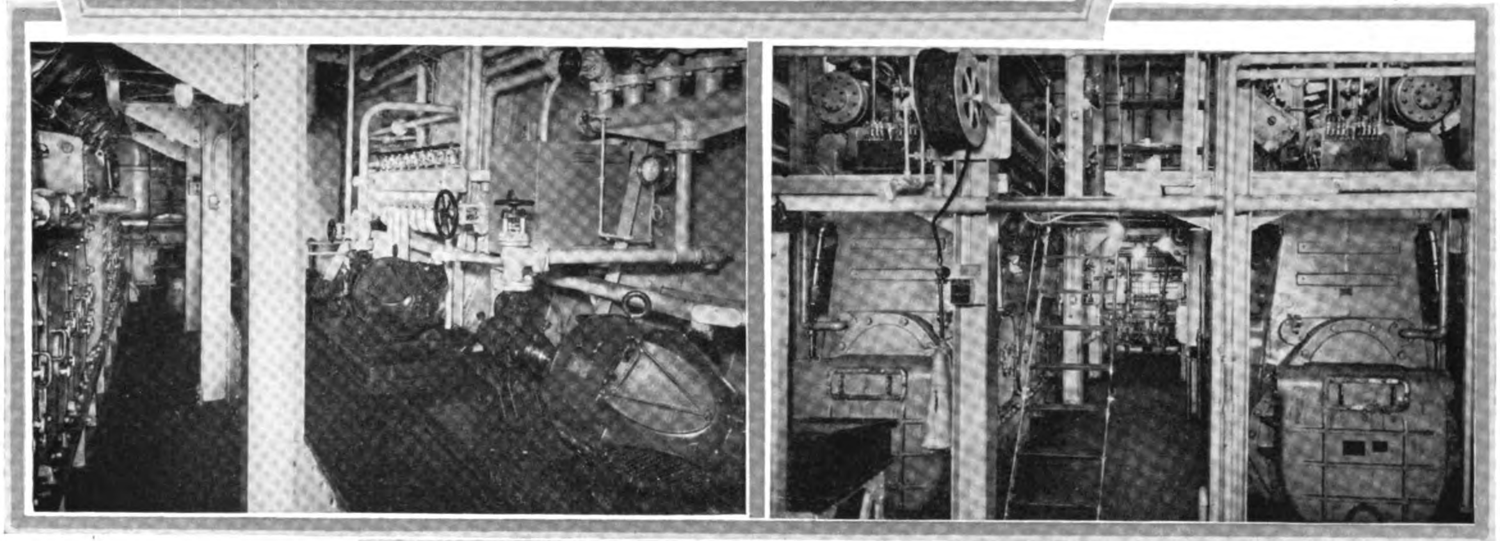
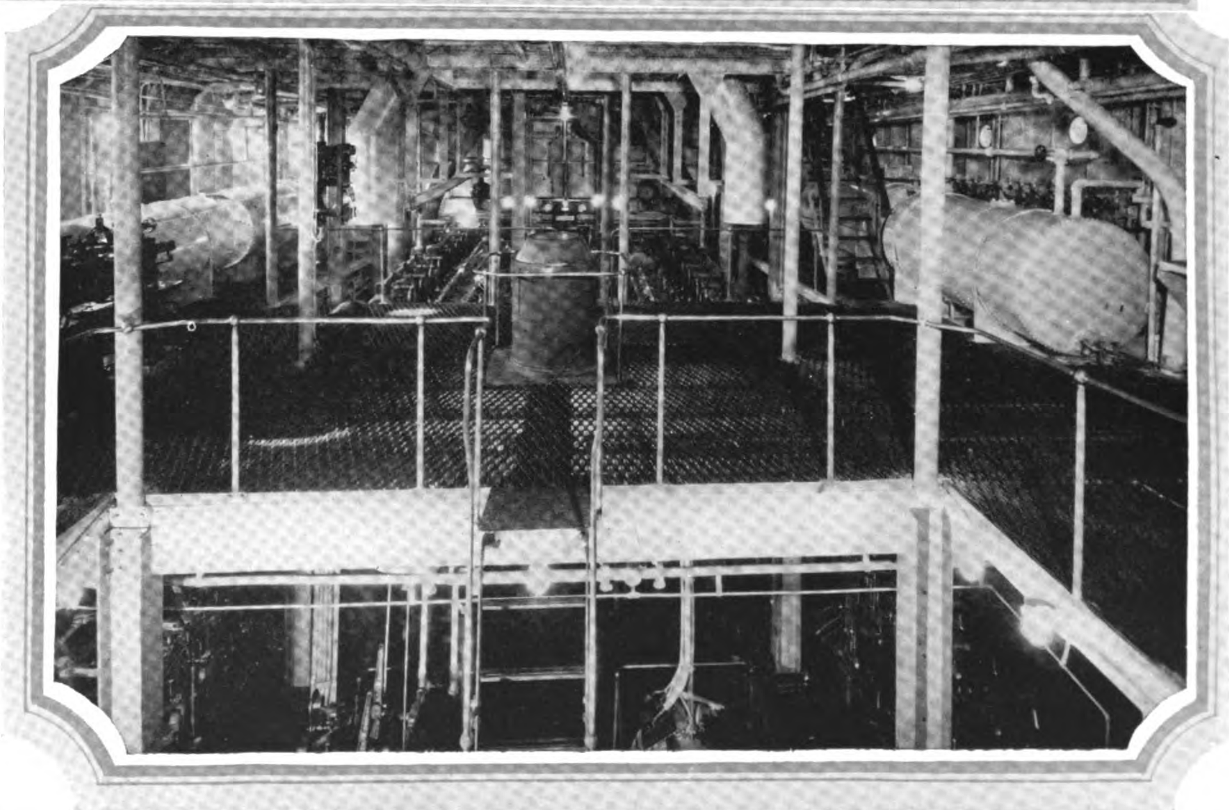


Three views of the engine room. The top one shows a good view of the valve mechanism of the main engines

The middle one shows view between bilge and fire pumps and the main engines on the port side

The bottom one shows the main platform with master compass





fied by the Thermofan system, which system takes air from the outside, screens and cleans it and passes this air over the heating or cooling coils and is then distributed to all the quarters by ducts and registers. Two of these units of 4,000 cu. ft. per minute at 2½-in. water pressure, which will heat the yacht to 75° F. at 0° F. outside temperature, or cool the air to within 5° F. of the sea water temperature.

Steam is furnished by an oil-fired boiler working at 15 lb. pressure of sufficient capacity to supply 1,800 lbs. steam per hour. This supplies the thermofans, the heating coils in the lubricating oil tanks and for direct heating to the pilot house, chart room and captain's quarters.

A 3½-ton per 24 hrs. evaporator and distiller with aërator is operated from the boiler. This distilled water is placed in a separator 300-gallon tank and can be used for boiler make-up or culinary use. This boiler is fitted with an oil burner.

A hot-water boiler fitted with an oil burner controlled by a thermostat is furnished to provide hot fresh water which is circulated by pump on a looped system to all bathrooms and toilets.

The salt and fresh water systems are composed of two pressure tanks of 1,000 gallons each, connected to two Kewanee pumps which maintain the pressure and operate between 40 lbs. and 20 lbs. These furnish fresh and salt water to all bathrooms and toilets.

The refrigerating plant is a Remington two-cylinder motor-driven ammonia machine complete with condenser, condenser pump, brine tank and brine pump. The refrigerators are a 600 cu. ft. box in the galley and pantry and a 2,000 cu. ft. storage box in the hold, this being divided into meat, vegetables, milk and butter and fish compartments, in each of which a different temperature can be carried. Three hundred pounds of ice can be made per day in addition.

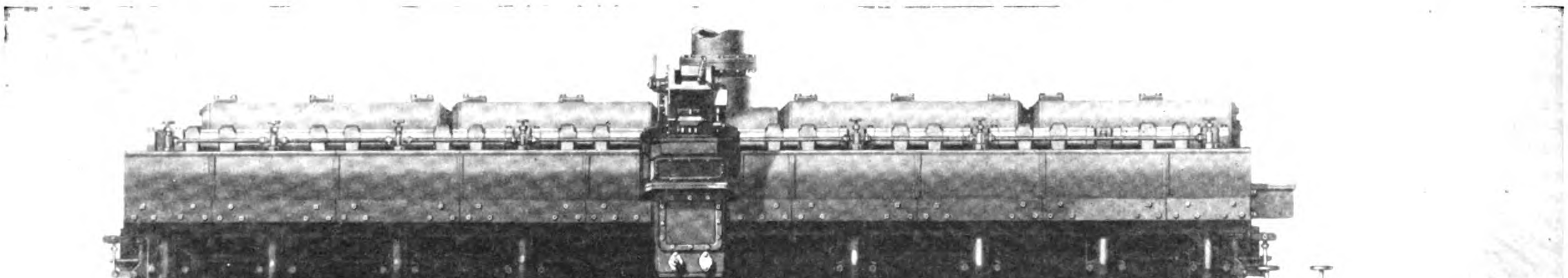
The waste from all the bath rooms and toilets are piped to sewerage tanks in which is a sump pump, controlled by a float switch.

The electric wiring is a complete wire and conduit job. No wire has less than 3/32-in. rubber insulation and no conduit is less than ¾-in. diameter carried clear to outlets. There are three generators, two of 110 k.w. capacity and one of 40 k.w., all 110 volt. d.c. A very important feature, which is illustrated herewith, is the large Edison storage battery group of 900 ampere hour capacity located in the upper engine room. This outfit can operate all the vessel's necessary equipment when she is at anchor.

Two three-panel switchboards are located on the middle grating made of ebony asbestos and completely equipped with switches, circuit breakers, rheostats, under- and over-load cutouts with voltmeters and ammeters. The steering gear is a Hyde hydro-electric controlled mechanically and electrically from the pilot house.

The yacht is completely equipped with the best of navigational instruments.. A gyro compass with four repeaters, revolution and direction indicators in engine room and pilot house, helm angle indicator, gyro pilot, 18-in. high intensity searchlight, two 12-in. spotlights on wings of the bridge, electric flashing whistle are installed, all of Sperry make. A Kolster radio direction finder, Star Actu-log, fathometer and Radio Corporation of America wireless set complete the navigational devices, and constitute the most modern equipment.

The windlass is a Hyde 35 h.p. double vertical capstan, fitted for 1⅝-in. stud link chain and capable of lifting both 4,000-lb. anchors and 30 fathoms of chain at once. The boat hoists are two Hyde 15 h.p. motor-driven double capstan type, capable of lifting 5,000 lb. at 100 ft. per minute.



Here is one of the two Bessemer 4-cycle, single acting, airless injection main Diesels of the SAVARONA. It develops 1,500 h.p. at 300 r.p.m. and is noteworthy for its simplicity, neatness and workmanlike appearance. The control station is at top platform level.

(Please turn to page eighteen)

An Aesthetic Harmony

Savarona, or Black Swan, is the Luxurious Well-appointed Home Taken Afloat

THE interior decorations of the magnificent motor yacht SAVARONA leave one impressed with the atmosphere characteristic of a well-appointed home rather than of a conventional yacht interior. Throughout, the decorations are French of the period of the XVIIIth Century, luxuriously beautiful in every detail, yet with a restraint consistent with good taste. In accordance with the owner's preference, they have been sustained in jade green varying in tone from that of turquoise matrix to the deeper colorings.

All of the panelings and architectural detail were designed by Mrs. Renner, interior decorator, of New York City, as were also the furniture, ornamental floors, and decorative ironwork. Great attention was given to the lamps and lighting fixtures which are unusually beautiful. In many places one finds the feather motif ingeniously adapted, as suggesting the name of the boat —*Savarona,* or Black Swan. This note, however, has been introduced insidiously rather than obviously, for nowhere is one impressed with the feeling of a definite play upon the name.

The living-room, amidships on the main deck, a spacious room with a beamed ceiling, is paneled in French walnut, Louis XVth period. A fireplace, in which a coal grate is used, has as its over-mantel decoration a fine old Chinese Chippendale mirror and on either side are built-in book shelves filled with old volumes.

About the room, covered with a taupé velvet carpet, such as has been used for all rooms of the yacht, are comfortable armchairs, some done in blue, pinkish amber and old gold brocade, some in striped silk of the same colorings. The full length curtains which have been used throughout, rather than the customary sill-length yacht curtains, are also of striped silk.

On one side of the room stands a Regence sofa covered in blue-green uncut velvet, at either end of which are small Louis XVth walnut tables holding carved wood triple-altar candlesticks, electrified. In front of the fireplace two smaller sofas have been placed and near them, old French tables, each holding an Italian gilded wood urn lamp with corresponding shades of beige and blue. Upon a Louis XVIth desk, at the left, are a pair of Chinese porcelain lamps in which the blue-green coloring again appears.

In a corner is the piano, and balancing this, on the other side of the room, a lovely old commode with a marbleized top, refinished in the prevailing blue-green tones of the room. Above these hang two interesting XVIIIth Century portraits and on each side of the room are painted oval back sidechairs. Showing graceful feathers in silhouette in the carved backs, the feather motif is again repeated subtly in the legs of the chairs.

The dining-room, forward, has a beamed ceiling and paneled walls and has been painted a delightful greenish tone. Above a marble-top green and gold console and the sideboard on the opposite side of the room are decorated mirrors by Pichenot, showing flamingoes amid a Chinoise garden setting of foliage and pagodas. On each wall, painted in the styles between the panels, are conventionalized palm trees.

The oval dining table, that can be extended to ample proportions, is finished in green and gold, as are also the large sideboard and two cabinets that were designed for this room. The carvings on these pieces are of unusual interest.

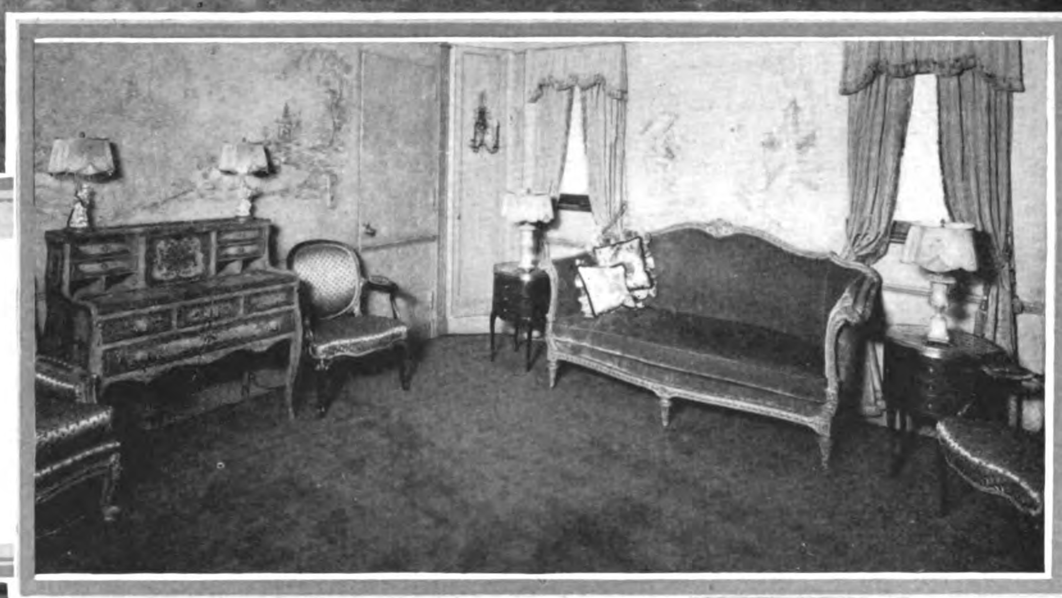
The frames of the Louis XVIth chairs are painted beige and are upholstered in blue-green damask, in which there are touches of the soft colorings of the flamingoes in the mirrors. This note has been repeated in the fringes of the heavy blue faille curtains. A pair of lovely old French porcelain cachepôts on the sideboard add interest to the decorative treatment.

Double sidelights about the room show a delicate design of sprays of wheat in silver and gold glazed with the wall color. The shades are of apricot silk, pagoda-shaped, charmingly decorated.

In the Observation Room, as the name implies, windows occupy the greater part of the wall space, yet on the two unbroken walls, above fine consoles of iron in old silver, are painted panels in Provençal motifs of birds and flowers, against a background of deep apricot. Blue has been used here for the finish of the lighting fixtures which consist of side brackets, between the closely set windows, that continue from the beamed ceiling to the floor in parallel lines, ending top and bottom in the feather motif. A pair of antiqued silver bird cages hang from brackets in the forward end of the room. The furniture consists of two beechwood sofas done in plain blue linen with quilted cushions, combining the colorings that appear in the painted wall panels; a Provençal flat-top desk, on which stands an old silver lamp, and four antiqued silver side-chairs, upholstered in blue linen, tufted, with soft contrasting colors. The curtains are of apricot linen embroidered in a running border design consistent with the decorations of the room.

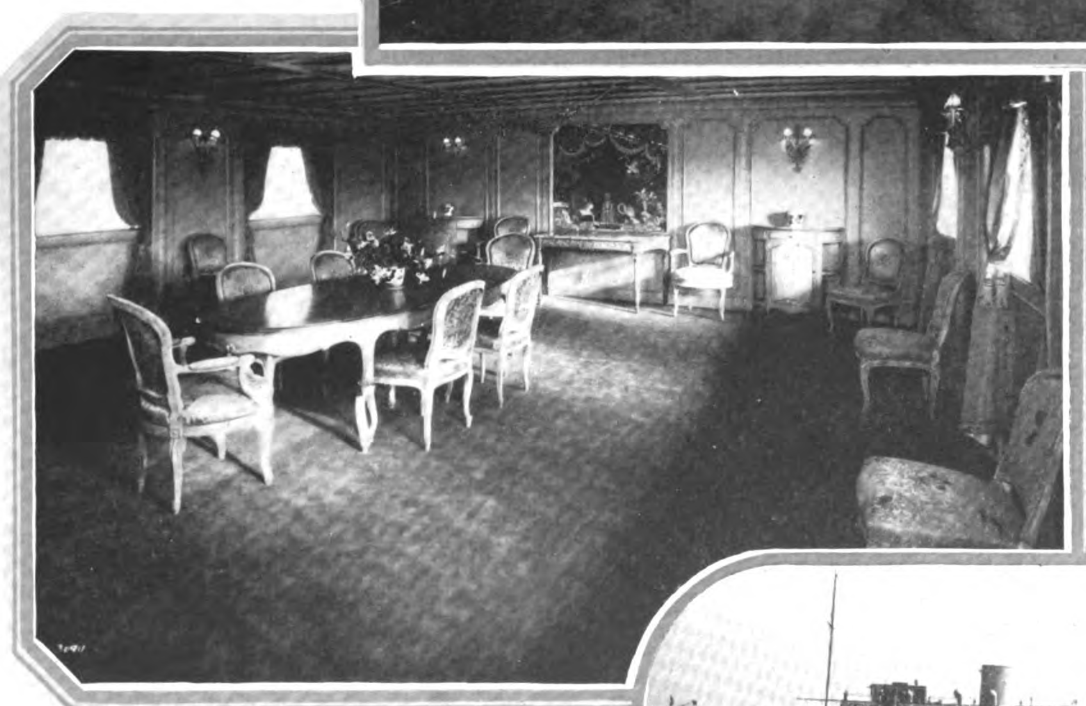
In the stern, on this same deck, is a comfortably appointed lounge with Provençal paneled walls of teak. The furniture is of beechwood and comprises a desk on which stands a pair of Chinese porcelain lamps, a sofa with armchairs to correspond, covered with blue uncut velvet, a pair of tub chairs done in dull blue, and a bench in coral, introduced as a color accent. Two occasional beechwood tables with tôle tops hold Chinese figure lamps and on two yellow and blue painted consoles, against the paneled wide walls, are four

(Please turn to page twenty)



A general view of the living-room, showing open fireplace

To the right is the owner's sitting-room

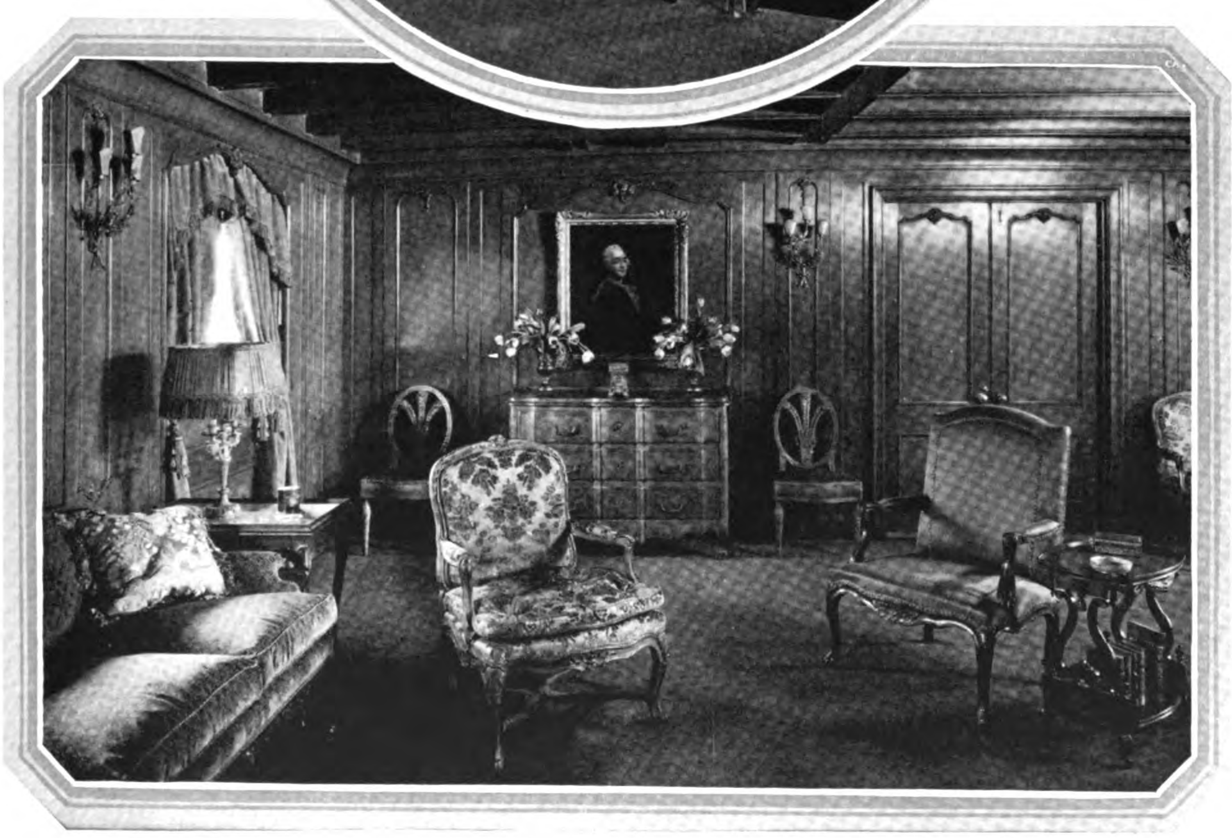


To the left is the splendid dining-room, luxuriously furnished and delightfully spacious

Above is the lounge looking forward; this room leads into the main foyer

One of the outstanding features of Savarona's equipment is the $25,000 Estey organ illustrated to the left

Hereunder is the living-room, 'midships on the main deck



branch antique gold candelabra with blue and amber shades. Above the consoles and between inset book shelves, hang decorative oval architectural paintings.

In the owner's sitting-room, on the main deck, amidships, the walls are again soft green with decoration in the style of Pillemon. The mantel and corner cabinets, with carved pilasters, are yellow, repeating the overtone of the changeable salmon silk hangings. The Louis XVIth chairs are in a scale pattern satin of blue and salmon and the sofa is covered in blue. An ivory and gold Louis XVIth desk and a bench with an embroidered cover of amethyst color are other incidentals. The side lights, suggestively Chinoise, have painted shades that harmonize with the color of the room.

The owner's stateroom adjoining, and the only one on the main deck, is in harmony with the adjoining sitting-room. In the main the furniture is antique ivory, several of the pieces charmingly decorated. The Louis XVI beds are most unusual and have embroidered spreads of great beauty.

Opening through a passageway connecting with the owner's bedroom is the Sun Room, one of the most beautiful rooms on the yacht and overlooking the after-deck.

Here a consistent treatment in Directoire green and gold marbleized walls and dark green pilasters with carved capitols is relieved by stiles in reddish pink. The chief decorative feature of the room is a landscape with figures. This fills the centre of one wall and covers the secret door leading to the owner's suite. Against the marbleized panels are two sofas with black and gold swans forming the arms. The frames are in green and gold and the coverings of striped material recall the color of the stiles. Two Directoire armchairs are covered with the same materials. The other chairs in the room are upholstered in gold color linen, with a painted design consistent with the period of the room, while beside the sofas are mirror-topped iron tables. Four torcheres in an Empire green stand in the corners of the room and the rail of the stair leading from this room to the cabin deck is one of the most beautiful details of the decoration of the boat.

A special terazzo floor, in harmony with the color and design of the furniture and sidewalls, has been used. The window hangings are of changeable green and gold linen with a painted border. The side lights, of green and gold bronze, with their details of berries, have parchment shades of gold color.

The single stateroom, on the cabin deck, is the only room with a built-in bed. This is set like an old Brittany wall-bed, with carved wood draperies and valances, painted in a soft green to correspond with the paneled walls. The furniture coverings and bedspread are of peasant linen, trimmed with pleated green ruffles. The porthole curtains are of plain linen with green pleatings. The furniture is finished in a gray-white, outlined in blue-green with flower decorations.

One double stateroom has been carried out in blue and rose, feather pattern chintz in the bedspreads and headboards of the beds, the window draperies, chair coverings and furniture painted in harmonizing rose and blue.

"B," another double stateroom, decorated in soft jade green and paneled in rose toile, has a dressing-room of corresponding colorings with a toile-draped dressing-table. "A," the main guest-room, shows putty colored walls, paneled in pale blue-green with a conventionalized painted feather border on the valances of the rose-silk window curtains. A blue-green feather chintz has been combined in the bedspreads with deep, blue-green taffeta flounces and pleated trimmings, and also provides the covering for the chairs. The furniture is painted a soft green with antique silver trim.

The decorations of Mrs. Cadwalader's bathroom lend the effect of a pavilion with a gold lattice dome ceiling, over blue, supported by black marbleized painted columns, entwined with vines that end at the top in conventionalized floor treatments. The intervening wall panels are blue-green with a surbase of black and green marble. Above this trim, a painted border shows the feather motif in a Persian treatment.

The bath, itself, with a black marbleized side finish, is set in an alcove where Pichenot decorated mirrors give the feeling of a deep perspective through a colorful Persian garden with pools and Oriental birds. The black marble floor is covered with leopard skins, and the wash basin and bath, of rose-colored porcelain, are fitted with fixtures of bronze doreé, similar to those used throughout the guest bathrooms and lavatories. The furniture is painted blue.

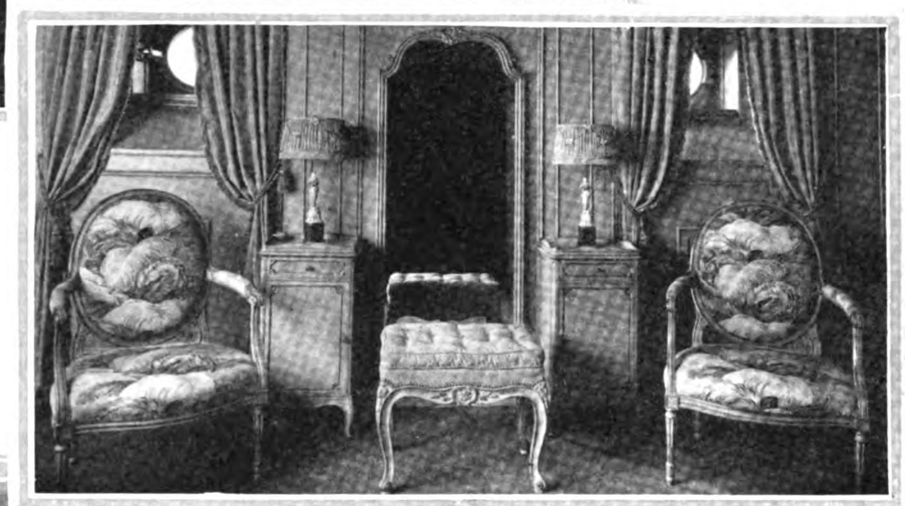
Mr. Cadwalader's bathroom corresponds in the general coloring but is somewhat more formal in treatment, in its paneled walls. A glass shower cabinet, in black marble, has been substituted for the bath.

In the guest bathrooms one wall treatment shows fish swimming about in limpid green water, and, in the black terazzo flooring, star-fish are used as a decorative motif. The bath and basin are of soft rose-colored porcelain and the fixtures gilt. The bathroom mirrors throughout are of unframed etched glass, in distinctive shapes.

Another bathroom, with marbleized walls, has been done in green and apricot with a rose-colored basin and bath. Walls of the two bathrooms of the largest guest-room repeat the dainty pink and blue lattice flower pattern of an old French print. These are relieved with a black marbleized trim.

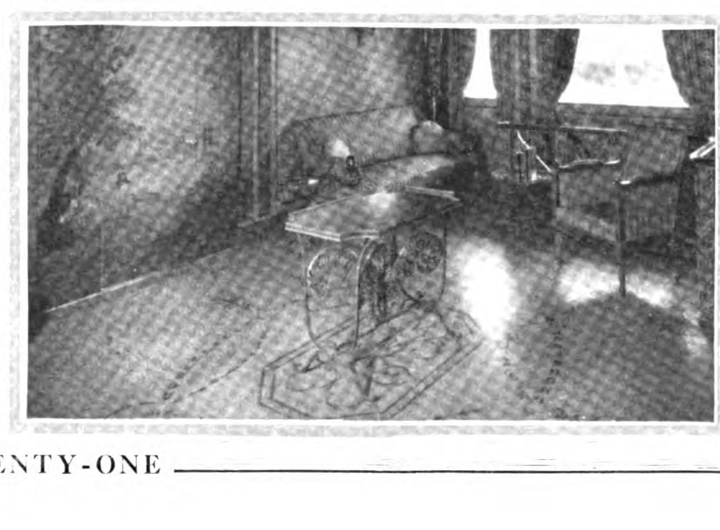
The lavatories throughout the yacht are marbleized and decorated with Directoire motifs such as the sea-horse, dolphin or swan, in gold, and, in one, the green shell-shaped basin is fitted with faucets representing gold-beaked black swans. All the bathroom floors are of terazzo or black marble.

(*Please turn to page twenty-two*)



Three views of typical guests' staterooms, with close-up of dressing-table and a vista through into the dressing-room beyond

A corner of the delightful Sun Room, an adjunct to the owner's quarters



The Big Bessemer Diesels in the *Savarona*

UNUSUAL freedom from vibration and a noteworthy simplicity of design characterizes the eight-cylinder 1,500 s.h.p. Bessemer Diesel engines installed in the Diesel yacht *Savarona*. Her machinery is of paramount importance as it is no small task to construct powerful high-speed Diesel engines to run with the smoothness and reliability so desirable with a luxurious pleasure vessel built for long-distance cruising.

Of the four-cycle, trunk-piston, airless injection type and with a bore of 18 inches and a stroke of 22 inches, operating at a normal speed of 300 r.p.m. these engines are making a record in service on the big yacht *Savarona*.

As shown in the illustration, on page 16, the general lines of the units are strongly reminiscent of recent automotive practice and this impression is further carried out when a detailed study is made of the structural details. A feature which will appeal to the operating engineer is the centralization of control, which is made possible by a recently developed control system which makes its first appearance on this model of Bessemer engine. There is also a high degree of accessibility, as any individual cylinder head can be removed with a minimum of labor and very little necessity for dismantling the cooling water connections or fuel operating gear.

The complete enclosure of the valve mechanism is another innovation which improves the appearance of the unit and adds an additional factor of protection not ordinarily found on an engine of this size.

The base of the engine is built in two sections of four cylinders each as is the cylinder block. All of the base castings and the other structural castings on the engine are made either of steel or of semi-steel, a feature which adds greatly to the torsional rigidity of the engine and has also been a feature in reducing the over-all dimensions of the unit.

On the forward end of the base is mounted a barring-over device, consisting of a pinion on the crankshaft operated by a worm gear, which in turn can be moved from the outside by a large ratchet wrench. This hand-operated barring-gear can also be fitted with a motor drive if desired. At the rear of the engine is mounted the flywheel and overspeed governor and a single collar thrust bearing.

The crankshaft is forged in two sections, each serving four cylinders. This shaft, which embodies the results of considerable investigation by H. F. Shepard, Diesel Engineer of the Bessemer Company, is built to very generous dimensions—the diameter of the main bearings and the crank bearings being 12¾".

In a series of exhaustive tests it has been found that there are no critical speeds up to 300 r.p.m., which is rather remarkable for an eight-cylinder engine of this size. It is therefore not surprising that at the normal speed of 300 r.p.m. the operation is as quiet and as relatively free from vibration as the most delicately balanced eight-cylinder automobile engine.